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TITLE:
"Use of Performance Measures to Evaluate, Document Competence and Deterioration of Advanced Surgical Skills Exposure for Trauma (ASSET) Surgical Skills". The Title was abbreviated as Retention and Assessment of Surgical Performance (RASP)

PRINCIPAL INVESTIGATOR:
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14. ABSTRACT

To address the decline in training programs and practice in exposing major vascular structure to control traumatic hemorrhage, the American College of Surgeons introduced a cadaver-based course to review the necessary surgical anatomy, procedure, skills, and techniques for rapid vascular exposure. A retrospective analysis of self-reported confidence in surgical procedures from 600 ASSET course participants showed that there was significant improvement in confidence after taking the ASSET course. An objective metric tool for assessing surgical skill has been developed through audio video recording 10 Expert and 10 Novice surgeons "thinking out loud" to determine discriminating criteria in surgical skill and technique. An analysis of 80 video clips determined that these criteria significantly discriminated Expert from Novice surgeons.

15. SUBJECT TERMS
Performance evaluation, ASSET, vascular trauma, surgical training, medical education

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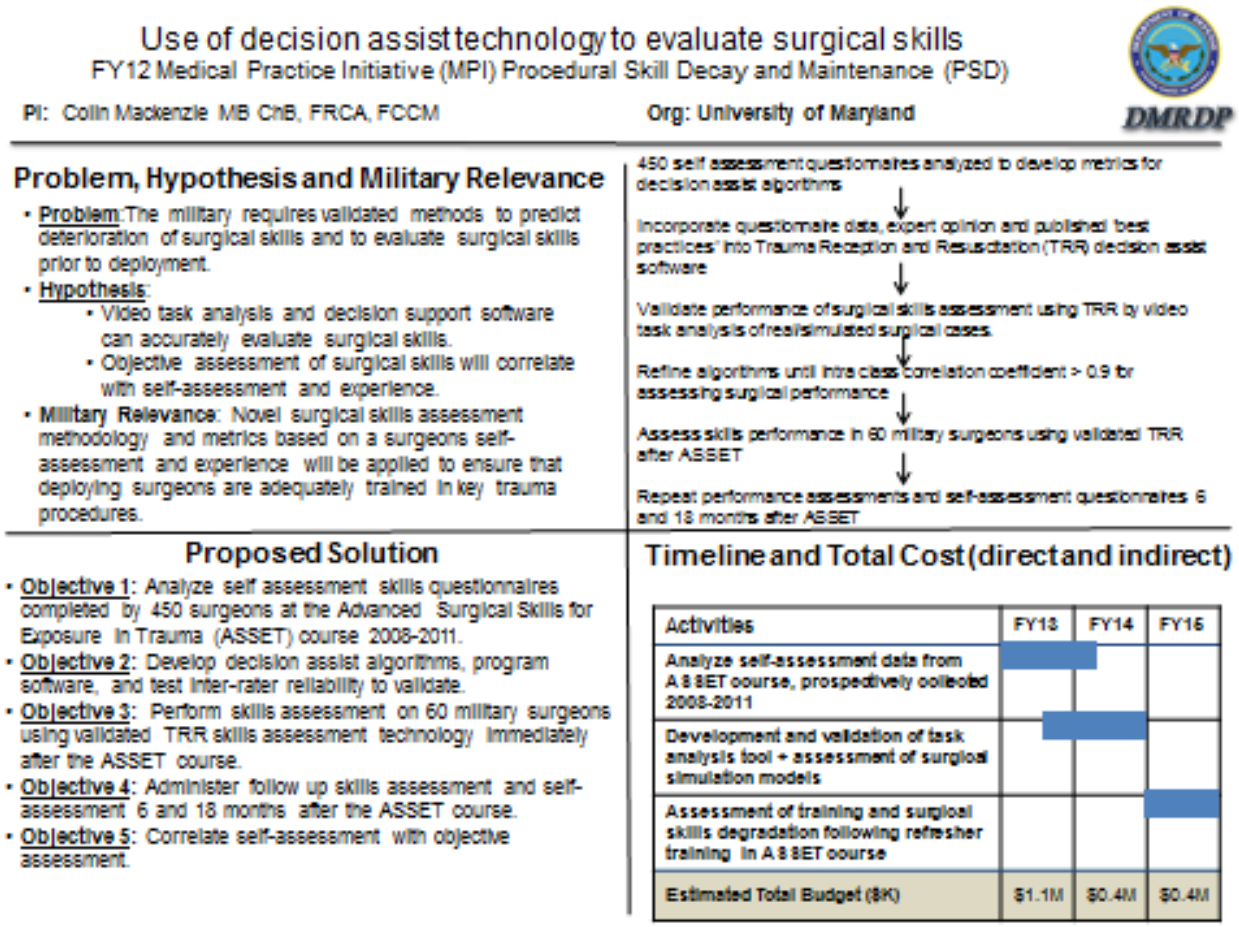
ANNUAL REPORT TABLE OF CONTENTS

Introduction

In cases of trauma, knowledge of major vasculature exposures is the primary step in gaining rapid control of hemorrhage. Bleeding is the leading cause of early death in military and civilian casualties, and both military and civilian trauma surgeons must maintain proficiency in the surgical exposure and control of major blood vessels. However, there has been a decreasing experience with vascular trauma among graduating surgical residents, thus the ability to objectively measure the acquisition, retention, and decay of surgical skills is crucial to training and maintaining casualty care teams. This project will demonstrate the utility of the Advanced Surgical Skills Exposures for Trauma (ASSET) course, developed by the American College of Surgeons Committee on Trauma, and assess, by developing performance assessment tools, the acquisition and retention of ASSET skills for 1- 5 years for upper and lower extremity hemorrhage control and lower extremity fasciotomy to provide critical insight into the duration and degradation of those skills over time. The process and procedures are summarized below.



Body

I. Statement of Work

1. Phase I – Preliminary investigations, TRR audit modification, and validation of Advanced Surgical Skills for Exposure in Trauma (ASSET) Performance testing methods

Task 1a) IRB submission; Kick–off meeting of clinical and research staff, months 0-2. Due Days from Award (DFA): 60 days; Acceptance Criteria (AC): Meeting minutes and presentation materials, IRB approval; Percentage of Cost (POC): 1%

Kick-Off Meeting Agenda February 14th

ASSET Funding Kick-Off Meeting
Thursday, February 14, 2013, 12:30pm – 4:00pm; Executive Board Room HSF II
Final Agenda

12:30	*Check in and light Lunch*
1:00 – 1:15 pm	Introduction Bruce Jarrell, Chief Academic and Research Officer (CARO), Senior Vice President, and Dean of the Graduate School UM Baltimore Tom Scalea, Professor of Surgery, Director Shock Trauma Center
1:15 - 1:30 pm	Medical Simulation Mr Tony Story (via Teleconference) , Telemedicine & Advanced Technology Research Center (TATRC). Armed Forces Simulation Institute for Medicine
1:30 - 1:45 pm	ASSET Overview and Summary Statistics Col (Rtd) Mark Bowyer, MD FACS, Director of Surgical Simulation The Normal M Rich Dept of Surgery Uniformed Services University (USUHS)
1:45 – 2:00 pm	ASSET History at UMB Sharon Henry, MD FACS, UMB
2:00 - 2:15 pm	USAF Military Perspective on ASSET and Study Col Stacy Shackelford, MD FACS, Director C-STARS Baltimore
2:15 - 2:45 pm	Study overview and SOW Colin Mackenzie, PI, UMB / STAR ORC
2:45 – 3:00 pm	Cognitive Task Analysis(via Teleconference) Valerie Shalin, PhD, Wright State University
3:00 – 3:20 pm	*Break*
3:20 – 3:40 pm	Maryland State Anatomy Board Ronn Wade, Director
3:40 - 3:50 pm	Budget and Financial Overview Lisa Gettings, STAR ORC

3:50 – 4:00 pm Study Coordination
Karen Murdock, STAR ORC

4:00 – 4:15 pm Timeline and Plans for achieving future deliverables of the ONPOINT Project
Colin Mackenzie, PI

4:20 pm Adjourn

Kick-Off Meeting Minutes February 14th : Attendees: Drs Bruce jarrell, Tom Scalea, Mark Bowyer, Sharon Henry , Rick Satav, Tony Story (Telecommunication from TATRC), Valerie Shalin (Telecommunication from Wright State University) + other, Catriona Miller, Chang, Julie Bosch, Karen Murdock, Lisa Gettings , George Hagegeorge, Ronn Wade, Joe Dubose , Stacy Shackelford, Colin Mackenzie , Peter Hu. **(Appendix 1)**

Task 1b) Acquisition of hardware, Trauma Reception and Resuscitation (TRR) software and equipment; months 0-2. DFA: 60 days; AC: Equipment etc acquired; POC: 5%

See attached Invoices for Acquisition of hardware (Appendix 2). See Attached TRR Acquisition (Appendix 3)

Task 1c) Analyze data from self-assessments provided by >600 past ASSET trainees, months 0-3; DFA:90 days; AC: Statistical analysis of dataset; POC: 3%.

See paper attached **(Appendix #4): Assessing Surgical Simulation: a Utility Analysis of the Advanced Surgical Skills for Exposure in Trauma (ASSET) Course.**
See important supporting data (in Supporting data: Figures 1-3; Tables 1-3)

Authors: Stacy Shackelford, MD, Evan Garofalo, PhD, Megan Holmes, PhD, Konstantinos Kalpakis, PhD, Sharon Henry, MD, , Mark Bowyer, MD, Colin Mackenzie MBChB.

Submitted to J. Am Coll Surg after receiving clearance from USAF STINFO

Task 1d) Audio-visual (AV) recording of "thinking out loud," and responses to questions on technical and non-technical skills and fidelity of physical models vs cadaver during ASSET procedures by 10 expert surgeons and 10 surgeons without prior ASSET training, months 3-7. DFA: 210 days; AC: Completion AV recording and AV data collection synthesis; POC: 10%

See attached Invoice for Acquisition of physical models (Appendix 5)

Task 1e) Revise all conventional assessment instruments in collaboration with the participants. **This Task 1 e) was accomplished by April 2013. During the "thinking out loud," by the 10 experts several key points became apparent that were then noted and included in possible discriminators. A consensus meeting of the experts occurred. Draft evaluation criteria were**

developed and then tested on 10 novice (2nd to fourth year surgical residents). With minor iterations occurring in the content and format of the evaluations as each successive novice candidate was evaluated.

Establish key steps and landmark evaluation points for the ASSET procedures from AV records, months 6-7. DFA: 210 days; AC: Revised assessments, ASSET steps and landmarks defined; POC: 6%

An Evaluator Training Handbook and training videos were developed before Inter-rater reliability Testing *(see attached Evaluator Handbook and Powerpoint Video presentations)* (Appendix 6 Evaluator training Handbook, and Appendix 7 [Powerpoint Video Presentations])

A Script was finalized for each of the four procedures. The Knowledge Content and Technical Skills assessments were finalized so that one script covered all four procedures with breaks between procedures. The breaks allow the sequence of the procedures to be changed so that 'carry-over' between before and after ASSET training was minimized. In addition this break was necessary so that one candidate would not hear the answers given or see the procedure being performed by another nearby candidate as might occur if they were doing the same procedures, at the same time alongside each other. (see Appendix 8 Script, Appendix 9, Script slides and Appendix 10 video evaluation sheet)

Task 1f) Modify TRR software to include these points, and conduct inter-rater reliability by multiple expert reviewers of ideal and non-ideal ASSET procedure performance, months 5-9. DFA: 270 days; AC: TRR Software modified and TRR Performance Audit tool validated; POC: 18%

Task 1f) Major Modifications of TRR software were accomplished by November 2013, but minor modifications are continuing as the evaluation metrics are standardized. We expect to have these minor modifications completed by April 2014. Inter-Rater reliability testing using 5 expert reviewers of 80 video records and the evaluations described above (under Task 1e), is summarized below in an Abstract Submitted to the Am Coll Surgeons for consideration to be presented at their Annual Scientific Meeting.

For this Abstract each of 5 experts reviewed video recordings of all the four procedures (Axillary, Brachial, Femoral artery exposure and lower extremity fasciotomy for all 10 experts and all 10 novices) Inter-Rater Reliability statistics (Intra-Class Corrleation ICC) are provided in the Abstract (see Appendix 15). An example of an Expert performance of an Axillary Artery exposure can be found in the digital file Appendix 16

2. **Phase II:** Using the revised and validated ASSET Testing tools developed in Phase I (as described in Task 1e), examine the efficacy of the ASSET training curriculum on acquisition and retention of ASSET skills, including the relative efficacy of unpreserved cadaver versus selected non-live-tissue models in skills training.

The relative efficacy of unpreserved cadaver versus selected non-live-tissue models in skills training was assessed using the attached questionnaire (Appendix 12). In addition another questionnaire was used to compare the unpreserved cadaver to a live patient (Appendix 11). In addition "a comfort level" questionnaire was completed before and after the initial assessments but before the evaluator de-briefing (Appendix 13)

Task 2 a) Train forty (in cohorts of 10) ASSET-untrained surgeons: test base-line skills, provide ASSET course, do post-test, months 10-17. DFA 510 days; AC: training and Phase 1 assessments complete; POC:15%

Task 2a) WE have enrolled 24 Phase 2 candidates as of March 12th 2014. Of these, twelve have undergone Pre-ASSET evaluations, ASSET Training and Post-ASSET-Training evaluations on both the cadaver and the physical models.

Twelve Phase 2 surgeons have undergone Pre-ASSET evaluations and are enrolled in the April 4th ASSET course and are already scheduled for Post-ASSET-Training evaluations. All Phase 2 surgeons have been scheduled on specific dates for their evaluations and for ASSET Training and Post-ASSET-Training evaluations on the cadaver and physical models.

Task 2 b) Mid-term review meeting with investigators and consultants - 2 days in month 18. DFA: 540 days; AC: meeting minutes and presentation materials as appropriate; POC: 1%

We will be scheduling this Mid-term review meeting shortly

Task 2c) Forty surgeons from 2a) perform 4 ASSET procedures in random sequence on physical model and cadaver, months 11-18. DFA: 540 days; AC: assessments for physical model v cadaver; POC: 10% **(see response to Task 2 a) above)**

Task 2 d) Revaluate 2b/2c surgeons at either 12 (n=20) or18 months (n=20) on physical model & cadaver. DFA: 990days; AC: TRR Performance Audit records and other performance assessments; POC: 15%

Task 2d) Will occur in 12 months' time.

3. Phase III: Examine various aspects of skills degradation over time, including comparison of skills degradation among 40 surgeons participating in past ASSET courses (cadaver model training only) and those participating in the study-based ASSET training curriculum.

We are currently about to send our recruitment letter to previously trained ASSET Surgeon for them to be enrolled in Phase 3 of this study.

Task 3a) Recall and retest previously ASSET-trained surgeons on cadaver at intervals of 2-5 years from original training, months 11-30. DFA: months 32-36 DFA; AC: Repeat ASSET procedures in 40 previously trained surgeons. Complete skills assessments as originally administered and TRR

Performance Audit; POC: 15%

Task 3b) Data analysis; draft paper and present results, 37 months DFA; AC: Final report acceptance; POC 1 %

Key Research accomplishments

- Identified and purchased light-weight head cameras with good video storage and streaming capabilities to allow for video capture of the procedures regardless of the depth of the dissection or orientation of the body (Task 1b).
- Completed a retrospective analysis of the effect of ASSET training on nearly 600 participants' self-reported confidence levels for ability to surgically expose and control major vasculature in 5 body regions and perform extremity fasciotomies and submitted to American Collecge of Surgeons for publication. For this particular paper, the effect of ASSET training was compared by experience level and body region (Task 1c; Attachment 4) and it is currently in review.
    - An abstract based on this study was also submitted to the Federation of American Societies for Experimental Biology and was accepted for presentation at the 2014 annual conference (Appendix 14)
- Purchased and accepted delivery of 30 of 100 physical model sets – models for extremity vascular exposures and leg fasciotomy (Appendix 5).
- Completed "thinking out loud" AV recordings for 10 out of 10 Phase 1 Novice surgeons.
- Compiled a comprehensive database of video clips demonstrating surgical technique as a method to train future reviewers.
- Developed a multi-media evaluator's handbook defining skill and technique points in a glossary and utilizing video to demonstrate ideal and non-ideal skills and techniques.
    - Trained a total of 9 surgeons and physicians and 3 anatomists using the developed evaluation criteria and handbook for the identification of ideal and non-ideal surgical technique and skills (Task 1e; Appendix 6, 7).
- Through questioning, AV recording, and "thinking out loud" exercises for 10 Expert and 10 ASSET-Novice surgeons, identified key criteria that evaluate, quantify, and distinguish an expert surgeon from a novice surgeon (Task 1d, e).
    - Developed a script and protocol to evaluate surgical skill and technique for both co-located and remote observation (Appendix 8, 9, 10).
- Conducted an inter-rater reliability study of 17 remotely reviewed video procedures compiled from the 10 Expert and 10 Novice procedures (Task 1f)
- Completed initial video evaluations of 80 videos recorded for the 10 Expert and 10 Novice surgeons. Observations on multiple surgical skill and technique points were found to significantly distinguish the two groups (see Task 1f for Appendix 15). This will be presented at American College of Surgeons and developed into a manuscript.
- Completed Pre- and Post-ASSET training evaluations for 12 of 40 Phase II surgeons, including performance of the procedures on both cadavers and models (Task 2a)
- Identified multiple fruitful areas for additional investigation and focus within this project.
- Finalizing draft letter to send to candidates for Phase III of the study.
- IRB continuing review was accepted and consent form stamp updated.

Reportable Outcomes

- One manuscript has been completed and is currently in review for publication in the *American College of Surgeons* (ACS) (Appendix 4).

    - Detailing the effect of the ASSET course on self-reported surgical confidence scores by level and years of experience.
- Two abstracts to be presented at Federation of American Societies for Experimental Biology (FASEB) and ACS annual meetings, respectively, have been completed from this research.
    - The abstract submitted to FASEB detailing the effect of the ASSET course on self-reported confidence scores by experience level and type of surgical specialty was accepted for presentation in the session entitled "Anatomy Education: Clinical Based Teaching Approaches" (Appendix 14)
    - The abstract submitted to ACS details the characteristics and observations of surgical technique and tissue handling skill that were found to successfully discriminate Expert and Novice surgeons (above, Task 1f, Appendix 15)

Conclusion

This project is progressing extremely well and is on target for all Statement of Work tasks. Institutional Review Board Approvals were obtained expeditiously. The Phase 1 comparison of Expert surgeons in comparison to Resident Surgeons was completed ahead of schedule. Preliminary Analyses of Phase 1 video task analysis(identified in this report) indicate that there is good inter-rater reliability for many of the evaluation criteria for distinguishing expert surgical technical performance. The Phase 2 studies comparing surgical technical skills metrics before and after ASSET Training are underway and 24/40 Phase 2 surgeons are enrolled. Phase 3 (previously ASSET Trained) recruitment letters are about to be sent. Phase 3 will examine important questions about surgical skills degradation over 2, 3. 4 or 5 years since training and the relationship with interval clinical experience.

Appendices

Appendix 1: Kick-off Meeting Minutes

ASSET Funding Kick-Off Meeting
Thursday, February 14, 2013, 12:30pm – 4:00pm; Executive Board Room HSF II
Minutes

Welcome by Dr Bruce Jarrell Chief Academic and Research Officer (CARO), Senior Vice President, and Dean of the Graduate School UM Baltimore and Introductions by Tom Scalea, Professor of Surgery, Director Shock Trauma Center were followed by a presentation (via Teleconference as all military travel was restricted due to "sequestration") by Mr Tony Story who was substituting for Dr Brett Talbot who was unavailable.

Mr Tony Story: Joint Program Committee One areas include: …Dr Jan Harris Program in Med Simulation and Training..Educational, gaming, information sciences, interoperability.

A) Med Simulation for Combat Casualty Care Training with Patient t Focus

B) Heath services protection

Objective to reduce live tissue training .. …develop new training methods by Oct 1st 2014 No animal use after 2015. SME reduce animals in training ….simulation to replace animals … integrate live animals and simulation.. when not possible to replace animals to augment training. Absence of standardization..and

procedures for training …policies to standardize training objectives. Gaps simulator deficiencies .. simulated blood not clotting ….tissue do not feel real , cannot be opened ..secretion characteristics are ifferent … variablility from one system to the next …no secretions..alter students perception ..lack of integration

TARC reviewed R & D portfolio …Tri Service committee tri service initiatives …develop a validation framework ….integrate with assessment tools ..JC P Combat casualty announce 2010..animal v tissue with simulator based systems. Effectiveness of performance of humans …clinical end points … AIBS made 4 awards ..ONR , U Missouri (2) , U Mich. Research Inter variability..airway hemorrhage …answer why and how….using cognitive task analysis tool ..critical cues guide what needs to be included in simulation and to determine what could be included in scenarios.

Simulation class compared animal v simulation… Trauma Hem Airway and EMS …U Mich..gap analysis differences in training…starting ..cholinergic crisis with U Missouri..U Michigan pediatric airway . Gaps identified ..SAS training animal based training,

Combat training system … simulation training and other Fasciotomy and Hem control and amputation. RDDCOM ….mannequin VR Laparotomy simulator….upper body mannekin..craniotomy and crniofacila hemorrhage ..work in progress ..awards for SBIR..advance simulators ..next Gen Haptic interfaces. Intergrated sensor technology …..for Trauma ..new tissues ..immersive training..facila and olfactory recognition …

ASSET Mark Bowyer..Emerg War Surgery Course

Covering incidence of training issues ..video clip of ASSET axillary artery …pictures ..references 1st Cours march 2008 UHUS . 2 faculty to 2 student course ..recommend 4 students to one Faculty …faculty teaches…..very intense . Ist 25 courses Finalized in 2010 i1o courses

Analyse data for 1st 25 courses in 2 year period..more than ½ practicing surgeons .. so Faculty can be Instructors av ys 9.1 y How comfortable..25 specific skills .. befoe and after comfort..follw up after course Universally weel accepted by surgeons. Ideal platform for skills retention. C-STARS .

Dr Sharon Henry .. Committee On Trauma of American College of Surgeons Trauma Skills and Beta site Claire Leidy ..equipment and coordinates..history of cadavers to teach 1997 ..each tem had a day in cadaver labe..not as rigorous of course …now better ..less residents ,,helped this course very structured ,, significant support .. support from Tom Scalea..State Anatomy 1949 .. Mr Body use in ATLS , surgical training and Ron Wade supported ASSET .. gets people to donoate 1400-1500 400 requests for cadavers in course per year ..Ist STC program trained the Instructors…New renovation of Anatomy Board. Train 4 students per cadaver..showed pictures of the cadaver lab…4 students do the work..anatomic cues at each cadaver sites .. refer to as need to do need a projector and fresh cadavers…11 courses 49 instructors 208 students ..importance of course ..should be mandatory course to all residents

COL Stacy Shackelford…Surgical Skills core to our mission at C-STARS ..Forward review in Afghanistan .. medical community exists ..confidence ,,the most dangerous job in the world .. I made it I am here they

know how good the medical care is …most meaningfull experience in my carrer emotional involvement when a police officer shot ..every day taking car of out nations heroes….DOD from Gulf war ..first deployment since Vietnam…..questioned ot bring back back and predict casualties ..many had never treated trauma patients ..or had no recent experience .

SS Described other training centers in response to this seemed lack. No test of whether they are capable of doing what they are needed to do when theu get to Afghanistan uS Military 41% 20% Local ANSF 53% IED's 25% GSW and mVC 80% by battle injuries

Surgeons at FSTeam Role 2 .. Role 3 by Navy lRMC Roe 4 GSW to areas not protected by body armor .. fasciotomy ..IED .. lung contusion ..also local trauma stabbed in chest ..MASSIE injury genitor urinaty injures ,,pediatric injuries ..surgical care in austere environment …two beds in OR ..care under constant threat of attack…half of hospital ..vehicle with epxpolsive devices. The bellding stops here..tean survival of casualties graph,,initial data 2005 midlle had consistent data ..av ISS up to up to 12 related ot blst inuries .fatality rates decreased now lest the 3% May 06- Mar 12th ..Hope that we can asses

Ron Wade .. Test HIV .. for ATLS ..disinfection solution … bodies presented to minimize risk 75-100 year prior disease ..less hostile candidates ..EMT and paramedics train on Cadavers …Ronn Wade involved early ..ATLS needed Drs Myers and Gens .. used cadavers for trauma procedures ..skeletal preparation areas converted in to clinical use. Enhance procedures ..within past 4 years upgraded ..second smaller area just opened .. obligation to family and honor their legacy..lab and Board determines responsible ..responsible to disposition to ashes or bury … as per 1975 medical school also serve on the Anatomy Board USUHS basic scientist ..have obligation to meet Army Board ..involved with military and STC for many years..increased interest in program..to use Anatomy Board resources …funds through DHMH ..self supporting entity .nominal fees to enhance services .

When simulation came in ..35 years cadaver …need pristine cadaver ..simualtion center offers more of that ,, not fresh specimens because of public health… efforts of donors and citizen of MD …70,000 donors on the books . Sensitive use of cadavers ..Army Policy .. get informed consent from donor and the family after donation ..organ tissue programs . Army cadaver donation is specific to military use .. .. IOAM organization since ..informed consent

Variation in cadaver cost 8K to 250 dollars across the US ..differences as State Board .Funeral costs are covered. Depends where you die . Costs of regulations …ofter coporate needs v education ,, gov v commercial ,,market value .. no legal value .. but realistically a commodity … . The MD State Anatomy Board need to meet needs 3 medical schools …commercial Stryker .. all institutional based .. transport ….1973 ..more uses ..but clinical physician allied health, resp therapy , anatomic specimens ..plastination and teaching specimens .. no surplus. .

Stipend not subject to institutional tax .. check will be processed on provision of SSN (and for direct participants with signed consent.

Karen coordination IRB status and getting system of research support in place .

Appendix 2: RCI invoice for AV hardware

2nd page for RCI invoice

Appendix 3: UMB Invoice for TRR system

1 page

Appendix 4: Assessing Surgical Training: a Utility Analysis of the Advanced Surgical Skills for Exposure in Trauma Course

Stacy Shackelford, MD, FACS[1], Evan Garofalo, PhD[2], Megan Holmes, BS[3], Konstantinos Kalpakis, PhD[4], Sharon Henry, MD, FACS[5], Colin Mackenzie MBChB[6], Mark Bowyer, MD, FACS[7]

Brief title: Assessing Surgical Training

Meeting presentation info: Not presented

Disclosures: This research was funded through US Army MRMC Award W81XWH-13-2-0028

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Abstract

Background: Surgical experience with managing traumatic hemorrhage has declined in training programs and in practice. To address this, the American College of Surgeons launched the Advanced

Surgical Skills for Exposure in Trauma (ASSET) course in 2010, a human cadaver-based course to review the anatomy, skills and techniques for rapid vascular exposures.

Study design: We compared self-reported confidence of participants (n=523) with surgical tasks (n=47) at baseline and directly after ASSET training to examine the effect of training. Median pre- and post-training self-reported confidence scores were assessed by Wilcoxon matched pairs test, directional change by Freeman-Halton contingency tests, and relative improvement for specific procedures using utility values assigned for each possible combination of pre- and post-training confidence levels.

Results: All surgeons recorded improved confidence in all five anatomic body regions after ASSET training ($p<0.0001$). Following the course, surgeons reported a high confidence level in 78% of the 47 procedures. The body region most improved by ASSET training was the upper limb, with 49% of surgeons improving from low to high confidence (Freeman-Halton 1x3 $p=0.017$). Residents/fellows achieved the greatest improvement in confidence levels. The highest utility value occurred with pelvic preperitoneal packing and retroperitoneal exposure of the iliac artery. The lowest utility occurred with exposure of the axillary artery.

Conclusions: This study highlights the broad positive impact of the ASSET course on trauma surgical skills. Confidence was most improved for residents/fellows. An objective performance measure of surgical skills would be valuable for future course development.

INTRODUCTION

Dramatic advances have occurred in the field of surgical training over the past decade in the areas of virtual reality simulation,[1-4] cadaver-based instruction,[5-8] and live animal models.[9-12] These training methods have helped to fill widening training gaps in surgical residency programs, as well as to create unique ways for practicing surgeons to maintain their skills.[13-17]

The Advanced Surgical Skills for Exposure in Trauma (ASSET) course, launched in 2010, is an American College of Surgeons approved human cadaver-based 1-day skills course that systematically reviews all of the major vascular exposures in the body. Emphasizing that vascular exposure is the requisite first step in achieving control of major hemorrhage, the course was designed to support not only trauma surgery but to improve the confidence of all surgical specialists who operate near major blood vessels. The course has been adopted in many residency programs as well as several military pre-deployment courses as a focused review of trauma surgical skills for surgeons who may or may not practice trauma on an ongoing basis.

The benefit of the ASSET course has been previously demonstrated through review of the initial participants' self-assessed skills for the vascular exposures taught during the course.[5,7] Now that experience with the ASSET course has increased, this paper will examine the benefits of the course utilizing a greatly expanded sample size and different outcomes incorporating pre-training experience and relative improvement with training. We aim to examine the effect of the ASSET course on surgical skills for surgeons of differing experience levels and for specific anatomic regions of the body.

METHODS

Data included in this study were collected from enrollment materials and a questionnaire given to ASSET course participants in 53 ASSET courses between 2010 and 2013.[7] Enrollment forms sent by the American College of Surgeons (ACS) gathered basic demographic and professional information including specialty, level of training and experience with specific surgical procedures. A questionnaire was given in

conjunction with the course to collect information about each participant's baseline self-reported confidence level with specific surgical tasks before ASSET training and with the same tasks directly after the training. Course participants rated their confidence with the procedures on a 5-point Likert scale[18] (1=no confidence; 5=a lot of confidence) for 47 procedures and surgical tasks.[5] For the purposes of analysis, Likert scale values of 1-3 were defined as low confidence and values of 4-5 were defined as high confidence.

To assess the self-reported benefits of ASSET training for surgeons of different levels of experience, participants were organized into three groups based on professional experience level. These groups were defined as residents and fellows, junior attending (<8 years post-residency), and senior attending (8+ years post-residency). The 47 surgical procedures taught in the course were classified into five body regions: upper extremity, lower extremity, neck, chest, and abdomen/pelvis. For each participant, confidence level change from before (pre) to after (post) ASSET training was determined utilizing various methods. Body region scores were determined for each participant using the median score of all procedures in each region before and after training and compared using Wilcoxon matched pairs test. The direction of change of confidence scores was determined (increase, decrease, stayed the same) for each category of surgeons using Freeman-Halton 3x1 (all surgeons) and 3x3 (by experience level and body region) contingency tests.

We also sought to describe an assessment of relative change before and after training for each procedure. A utility value for each possible combination of pre- and post-training confidence levels was assigned with the greatest positive value given to any improvement resulting in a self-confidence level of 5 after the course and the lowest positive value to a self-confidence score of 1 after the course, with null indicating no change. Corresponding negative values were assigned for a lowering in self-confidence scores. The methods of assignment of specific utility values assigned are illustrated in Figure 1. We computed the average utility value for the participants' pre-training and post-training scores, grouped by procedure and participant's experience level. We then collected these averages into a matrix, where rows

correspond to procedures and columns to experience levels. This matrix, constructed using MATLAB 2012b, is displayed using the heatmap technique[19] in Figure 2.

RESULTS

Five hundred twenty-three surgeons completed the ASSET course surveys before and after the course. Two hundred four attending surgeons recorded their specialty and all (n=523) recorded their experience level. Of those who recorded their surgical specialty, 41% were general surgeons, 29% trauma/acute care surgeons, 12% orthopedic surgeons, and 17% other surgical specialists. By experience level for all surgeons, there were 244 residents and fellows and 279 attending surgeons, of whom 171 were junior and 108 senior attendings. The mean (± standard deviation [SD]) experience level of residents/fellows was post-graduate year 4.5±0.5, junior attendings 3±2 years in practice, and senior attendings 18±8 years in practice. The mean (± SD) number of selected procedures performed by each experience level are illustrated in Figure 3.

Confidence level changes pre- and post-ASSET training

For all experience levels, surgeons recorded significantly higher confidence to perform procedures in all five anatomic body regions after ASSET training (Wilcoxon matched pair $p<0.00001$). Median pre- and post-training confidence levels are displayed in Table 1.

Prior to attending the ASSET course, survey of all surgeons demonstrated that 39% of surgeons reported a high confidence level for all regions combined, with the lowest pre-course confidence in chest (30% high confidence) and highest pre-course confidence in abdominal/pelvic procedures (48% high confidence); all of these surgeons also reported high confidence after the course and are illustrated in Table 2 in the category "stayed high". Following the course, 78% of all surgeons reported a high confidence level for all regions, including surgeons who improved from low to high (39%) and surgeons who stayed high (39%). Of all surgeons who initially reported a low overall confidence level, 20% retained a low overall confidence after the course (Freeman-Halton 1x3 $p=0.025$) (Table 2).

The ASSET training improvements stratified by body region based on the percentage of surgeons changing from low to high confidence after the course occurred in the following order (greatest to least improvement): upper limb, chest, lower limb, neck, and abdomen/pelvis (Table 2). In upper limb procedures, 49% of surgeons improved from low to high confidence while another 33% started and stayed high (Freeman-Halton 1x3 p=0.017). By comparison, surgeons reported the least overall improvement in abdomen/pelvis procedures, largely due to a high starting confidence level of 48% which stayed high and 32% of all surgeons moved from low to high confidence in abdomen/pelvis procedures (Freeman-Halton 1x3 p=0.001) (Table 2).

Confidence scores stratified by surgeon experience demonstrated that more residents and fellows recorded a pre-course low confidence level for all body regions of 69% compared to 54% of junior attendings and 45% of senior attendings; post course outcomes for those with a low starting confidence are illustrated in Table 3 as a change from "low to high" or "stayed low". The percentage of surgeons who recorded high pre and post confidence ("stayed high") increased significantly with experience level for each body region, with corresponding lower rates of converting from low to high confidence. (Table 3)

Assessment of utility

The utility values for all starting confidence levels 1 through 4 are illustrated in Figure 2, with darker shades corresponding to the highest utility and lighter shades to the lowest. The matrix displays the average utility value of pre-/post-training scores; the legend provides the mapping of matrix values to colors, while average utility values are also shown in each individual cell. The lowest average utility was obtained for exposure of the axillary artery, indicating the least improvement in confidence level with training. Various intra-abdominal exposures, femoral artery exposure, and lower extremity fasciotomy also received relatively low utility values. The highest utility was achieved with pelvic preperitoneal packing and retroperitoneal exposure of the iliac artery. This analysis provides a useful course

development tool, illustrating how training has affected confidence levels for each specific procedure taught in the course. All utility values were significant ($p<0.05$) except packing the liver for hemorrhage for senior attending.

DISCUSSION

The epidemiology of traumatic injury has gradually shifted over the past five decades, with a number of factors such as improved prevention,[17,20-22] violence outreach programs,[23-27] non-operative treatment of solid organ injuries[13,28-29] and penetrating abdominal wounds,[30-32] and rapid advances in interventional radiology[33-34] combining to reduce the total number of operations performed by individual surgeons. Additionally, the implementation of work hour restrictions for residents in 2003 reduced the total in-hospital work hours to 80 hours/week.[35] Total operative trauma cases for graduating general surgery chief residents have decreased from an average of 60.4 cases per resident in 1999 to 33.5 cases in 2012. In particular, major vascular procedures decreased from an average of 8 cases per resident in 1999 to 0.7 cases in 2012.[36]

Advances in surgical training have simultaneously progressed, potentially offering a mechanism to develop and maintain skills outside of actual patient care. Advanced laparoscopists embraced simulation training early. Numerous analyses have been conducted to assess the efficacy of laparoscopic simulation trainers, especially as the technology has rapidly advanced from low-fidelity physical models to high-fidelity virtual models. The majority demonstrate a significant increase in both learner confidence and proficiency.[4,37-39] A number of cadaver and live animal simulation models have further advanced surgical skills training.

The ASSET course, launched in 2010, was developed by the American College of Surgeons to systematically teach exposure of all major blood vessels in the body along with fasciotomy of upper and lower extremity using a human cadaver model. These skills are important for management of major hemorrhage in traumatic injury. Beginning with the first ASSET course, a detailed questionnaire of

surgical experience and pre- and post-training confidence level with each of the 47 procedures taught in the ASSET course was collected. Confidence level was assessed using a Likert scale[18]. Our analysis demonstrated that surgeons of all specialties enrolled and all experience levels derived benefit from the course by improving overall confidence levels with vascular exposures. Confidence was most improved for procedures in the upper limb. Additionally, residents/fellows achieved the greatest improvement in confidence levels.

This method of surgical skills assessment has many limitations. The individual surgeon's experience with procedures was recorded as an estimate from memory and does not represent an exact count of actual procedures performed. Additionally, the self-reported confidence level for each procedure is a subjective measurement that may vary significantly from one subject to the next, or at different stages of experience in the same individual. Also, due to the large number of procedures queried, an element of survey fatigue may have reduced the accuracy of results, particularly when comparing pre- and post-scores for specific procedures. We sought to group the 47 specific procedures into body regions for the purpose of analysis to reduce the potential variability. However, ultimately this still remains a subjective assessment of surgical skills, and a more objective measurement of surgical performance by trained evaluators, including competence evaluation as described for orthopedic surgeons[40] is needed, rather than self-assessment.

Medical training in general, and simulation based training in particular, have suffered from a lack of objective outcome measures, with confidence levels commonly used as the outcome measure.[41-43] In most cases, assessing emergency skills on actual patients would not be possible due to the infrequency of specific life-threatening conditions and the challenges of observing and recording emergency treatments. An objective test of surgical skills would be useful in a number of situations. Such a test would be beneficial to assess the effectiveness of a specific surgical skills course or perhaps to show improvements in technical skills throughout an entire residency program. An objective skills test could be a useful way to compare different teaching methods. The military has an expressed need to ensure that deploying

surgeons are prepared for their upcoming mission. And finally, it is conceivable that an objective surgical skills test could be incorporated into board certification or recertification in the future. An objective means of assessing surgical skills does not currently exist.

CONCLUSION

The ASSET course is an effective training method that increases surgeons' confidence levels in performing trauma-specific exposures. Although there were significant differences in the degree of improvement between different experience levels, confidence levels improved for all categories of surgeons in all body regions. Confidence was most improved for procedures in the upper limb. Residents/fellows achieved the greatest improvement in confidence levels. An objective performance measure of surgical skills would be valuable to refine future course development.

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Figure 1. Utility function displays values assigned to each combination of pre- and post-training confidence scores. Greater value was assigned to higher post-course confidence levels and to larger improvement, e.g. a change from Likert scale score of 1 pre- (shown on Y axis) to a score of 5 post-training (on the X axis) was assigned a maximum utility score of 100, whereas from 1 to 3 was assigned a score of 50. Negative values were assigned to decreases in confidence levels. Results of utility analysis are displayed in Figure 2.

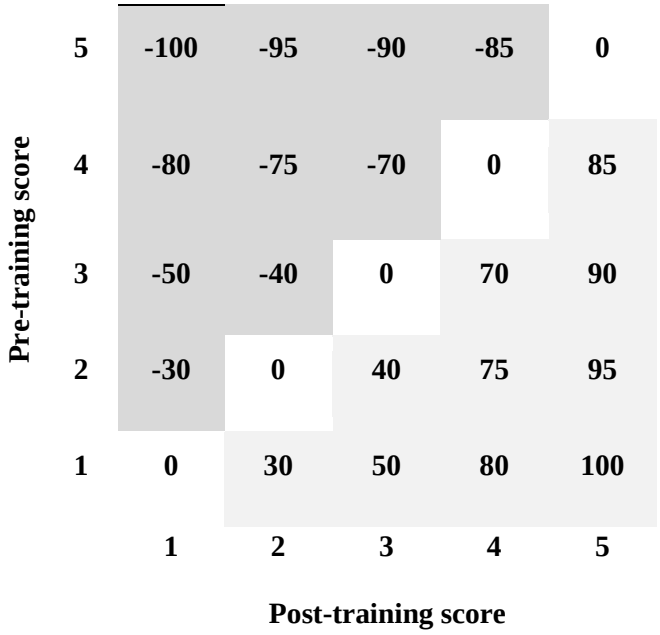

Figure 2. Heat map displays the average utility for each procedure taught in the ASSET course. Darker shades correspond to the highest relative improvement and lighter shades to the lowest.

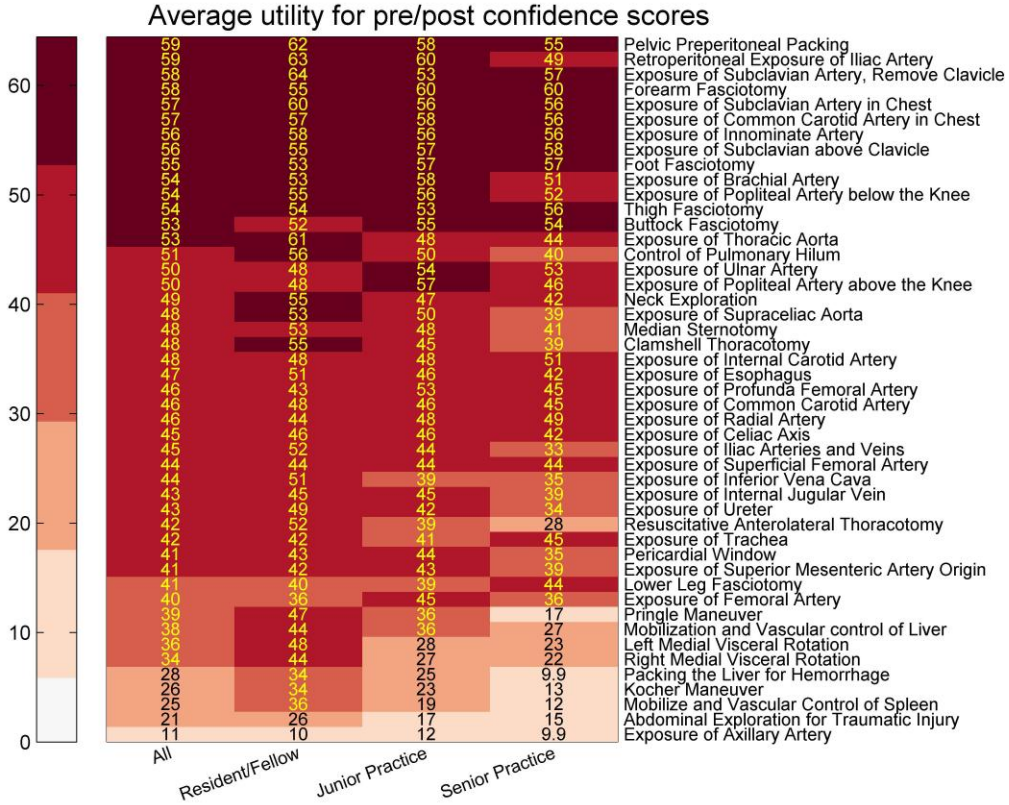

Figure 3: Average reported number of selected surgical procedures performed during surgeons' career displayed by experience level (average number of years of experience: Resident/Fellow: post-graduate year 4.5±0.5, Junior Attending: 3±2 years, Senior Attending: 18±8 years).

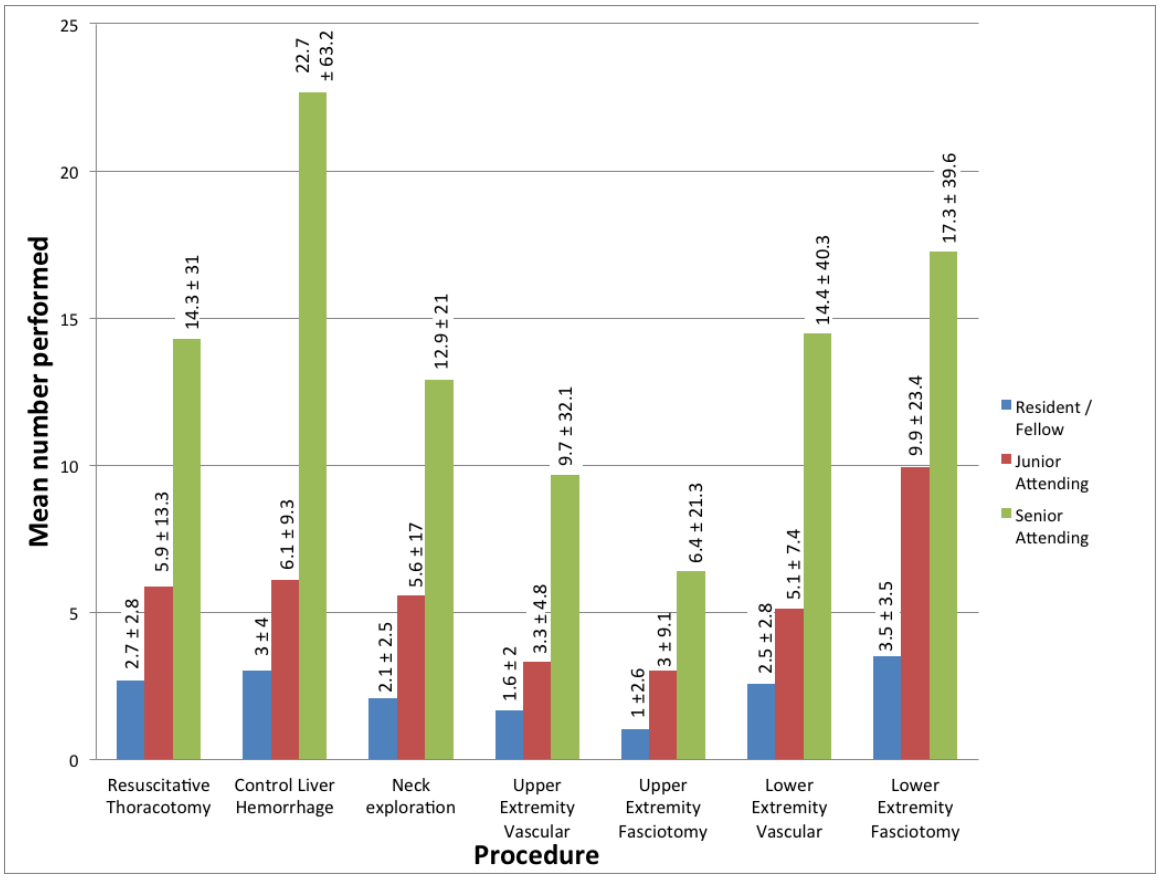

Table 1: Median (Interquartile range) for Pre- and Post-Confidence Scores of Each Anatomic Body Region and Experience Level**. (**$p<0.00001$ for all pre- and post-score pairs)

	Resident/Fellow		Junior Attending		Senior Attending		All Surgeons	
Body Region	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
Upper Limb	3 (2-4)	4 (4-5)	3 (3-4)	4 (4-5)	3 (2-4)	5 (4-5)	3 (2-4)	4 (4-5)
Lower Limb	3 (2-4)	4 (4-5)	4 (2-5)	5 (4-5)	4 (3-5)	5 (4-5)	4 (2-4)	4 (4-5)
Neck	3 (2-4)	4 (4-5)	4 (3-4)	4 (4-5)	4 (3-4)	5 (4-5)	3 (2-4)	4 (4-5)
Chest	2 (2-3)	4 (4-5)	3 (2-4)	4 (4-5)	3 (2-4)	4 (4-5)	3 (2-4)	4 (4-5)
Abdomen/Pelvis	3 (2-4)	4 (4-5)	4 (3-5)	5 (4-5)	4 (3-5)	5 (4-5)	4 (3-5)	4 (4-5)
All Regions	3 (2-3)	4 (4-4)	3 (2-4)	4 (4-5)	4 (3-4)	5 (4-5)	3 (2-4)	4 (4-5)

Table 2: Change in Self-Reported Confidence Level after ASSET Training on a 1-5 Likert Scale, Displayed as Percent of All Surgeons. Low confidence is defined as Likert 1 to 3, high confidence Likert 4 to 5. P-values are given for Freeman-Halton 1x3 contingency testing.

Confidence Level Change	**All Regions**	**Upper Limb**	**Lower Limb**	**Neck**	**Chest**	**Abdomen/ Pelvis**
All Surgeons						
Low to High	39	49	40	39	45	32
Stayed Low	20	17	22	20	24	18
Stayed High	39	33	37	40	30	48
Freeman-Halton 1x3 p-value	0.025*	<0.0001*	0.060	0.021*	0.017*	0.001*

*p<0.05

Table 3. Change in Self-Reported Confidence Level after ASSET training on a 1-5 Likert Scale, Displayed as Percent of Each Experience Group. Low confidence is defined as Likert 1 to 3, high confidence Likert 4 to 5. P-values are given for Freeman-Halton 3 x 3 contingency testing.

Confidence Level Change	**All Regions**	**Upper Limb**	**Lower Limb**	**Neck**	**Chest**	**Abdomen/ Pelvis**
Resident/Fellow						
Low to High	46	52	42	45	52	43
Stayed Low	23	22	27	24	26	20
Stayed High	30	25	30	30	21	36
Junior Attending						
Low to High	36	51	42	36	42	24
Stayed Low	18	10	15	16	23	20
Stayed High	45	38	42	47	34	55
Senior Attending						
Low to High	31	44	37	33	35	21
Stayed Low	14	11	18	15	19	11
Stayed High	53	44	44	51	45	66
Freeman-Halton 3x3 p-value	0.019*	0.013*	0.125	0.031*	0.007*	<0.0001*

*p<0.05

Appendix 5: OEI invoice for physical models

1 page

Appendix 6: Evaluator Training Handbook
28 pages

Appendix 7: Evaluator Training video

Please see digital file of the same name

Appendix 8: Evaluation script

RASP study Instructions, 1st Trial

"You are here today to participate in a study during which we will evaluate your current knowledge and skills regarding the management of patients with certain traumatic injuries.

We will present you a total of four cases that will focus on dealing with specific traumatic injuries.

For each case, I will ask you to first describe:

1. The structures that you suspect might be injured.
2. The physical findings you would specifically look for.
3. The need for any additional studies and treatments.
4. The need for surgical intervention.

We will then transition to the patient being in the operating room and I will ask you to:

1. Describe how you would position and prep the patient for surgery.
2. Mark the key landmarks for your incision.
3. Perform the indicated procedure using the available instruments.
4. As you perform each procedure you will be asked to speak out loud, describing the steps as you perform them.
5. It is not necessary to rush through the procedure.
6. Once you start the procedure, I will try not to interrupt you.
7. Perform the procedure as you would in a live patient to allow accurate assessment of your surgical technique.
8. You will have 20 minutes to complete each indicated procedure. Time will begin at your first incision.

Do you have any questions before we proceed?

Name of Evaluator: **Date:**

Name of Candidate: **(Circle timing): Pre Post**

1st Trial

Circle type of trial: Cadaver / Model

Case One: Axillary Artery

Case Presentation:

- **You are called to the Emergency Department to see a 24 y/o male who was shot during an attempted robbery sustaining a single gunshot wound to the upper anterior lateral Right/Left Chest.**
- **He was reported to have a large amount of bright red blood at the scene, but is currently not bleeding.**
- **He is complaining of pain at the site of the wound and inability to move his arm.**

[Advance slide to show image of wound]
[Advance slide to continue narrative]

- **He is awake and talking with bilateral and equal breath sounds and a BP of 80/60 and a heart rate of 130 after 2 liters of lactated ringers**
- **There is a single wound as seen with no other obvious trauma and no "exit wound". His hand is cool and pale.**

Question #1. What are the structures you suspect could be injured along the path of the bullet?

Expected Answers checklist:

The participant described each of the following as potentially injured:		
	Yes	**No**
Axillary Artery		
Axillary Vein		
Brachial Plexus		
Lung		
Subclavian Artery		
Subclavian Vein		
Mediastinal structures		
Bones		

Question #2. What physical findings will you look for to help you decide which structures are injured? Include signs of vascular, thoracic, nerve, and bone injury.

Expected Answers checklist:

The participant describes each of the following physical findings and tests:		
	Yes	**No**
Decreased breath sounds		
Active arterial bleeding		
Enlarging or expanding Hematoma		
Absent distal pulses		
Distal Ischemia		
Bruit or palpable thrill		
- Indicates that any or all of above are “hard signs” of vascular injury		
Active venous bleeding		
Unequal blood pressure, decreased Brachial-Brachial Index		
Doppler pulses—diminished flow		
Sensory loss		
Loss of motor function – weakness, inability to move arm		
Bony instability, deformation, crepitus		
Sub-cutaneous air		
Tracheal deviation		

The patient's blood pressure is 85/65 and HR 110 and is unable to move his arm, has decreased sensation and absent brachial, radial, and ulnar pulses.

Question #3:

What additional studies would you perform to help you identify or rule out specific injuries in this patient?

Expected Answers checklist:

The participant described each of the following as additional studies		
	Yes	**No**
FAST exam to look for pericardial tamponade, hemothorax, pneumothorax		
Chest X-ray		
A marker (eg paperclip) is placed to mark wound prior to x-ray		
Error: Fails to obtain CXR		
CT of Chest (zero points)		
CT Angiogram (zero pts)		
Angiogram (zero points)		
Error: Inappropriate use of CT or Angio*		

All of the above tests are acceptable possible studies but the participant should clearly indicate these tests <u>should only be done in a hemodynamically stable patient</u>. Without this qualifier, performing any of these tests prior to taking this patient to the OR has potential for negative outcome & should result in negative value scoring.

***Scoring Note: no additional points are added for additional studies**

[Advance slide to show Chest x-ray]

A chest x-ray has been obtained and shows no evidence of hemo or pneumothorax. There is a bullet fragment adjacent to the mid-portion of the ipsilateral scapula just superficial to the skin of the back – In other words a bullet trajectory from front to back on the same side, which does NOT involve the thoracic cavity.

Now the BP is 89/69 HR is 110. There is no other obvious trauma and his hand is cool and pale.

Question #4:

Now that you have seen the wound, physical findings, and chest x-ray, what is your plan for this patient?

If the participant suggests a non-operative course – they should be informed that: **the patient is now in the operating room and needs exposure and control of the axillary artery.**

Expected Answers checklist:

The participant states the following plan		
	Yes	**No**
Patient should be taken urgently to the Operating room		
Error: Delay in going to the operating room		

Question #5:

What is your plan to resuscitate this patient? Include fluids or medications you would use during the initial resuscitation.

Expected Answers checklist:

The participant describes each of the following additional items the patient might receive:		
	Yes	**No**
Resuscitate with blood products		
Transfuse with high ratio of blood:FFP:platelets/ Massive transfusion protocol		
Minimize crystalloid infusion		
Limit volume resuscitation until bleeding controlled		
Do not delay surgery for resuscitation, resuscitate in OR		
Give TXA		
Large bore IV access		

The patient has now been transported to the Operating Room and is on the OR table in front of you.

Question OR # 1:

How would you position and prep this patient in order to repair this injury and explain why you chose to prep as you did?

Expected Answers checklist:

The participant Indicates the following in response:		
	Yes	**No**
The patient should be supine		
The arm extended on an arm board		

The prep should include:		
The Entire Chest		
States possible need for sternotomy for proximal control		
The Entire arm and hand on the affected side		
States need to evaluate perfusion to the hand		
The thigh/groin for possible vein harvest		
The neck		
States possible need to expose subclavian artery for proximal control		
Error: Fails to prep entire chest		
Error: Fails to prep entire arm and hand.		
Error: Fails to prep the thigh for vein harvest		

Question OR # 2:

At this time, please describe and then mark on the skin the landmarks and the incision that you plan to use.

Expected Answers checklist:

The participant Indicates the following in response:		
	Yes	**No**
The sternal notch		
The clavicle		
The deltopectoral groove		
Incision runs from mid-clavicle laterally in deltopectoral groove.		

EXPOSURE OF AXILLARY ARTERY

"Now I would like you to get control of the Axillary Artery proximal to the wound by dissecting and placing a vessel loop around the artery. As you operate, speak out loud and identify each step of the procedure. It is not necessary to rush through the procedure—you should operate at a comfortable pace. The procedure will be deemed complete once you have placed a vessel loop around the axillary artery to obtain proximal control. Do you have any questions? If not please proceed."

Expected operative dissection performance checklist:

The participant describes and performs each of the following steps:			
	Yes	**No**	**Time**
Initial skin incision is adequate to perform exposure			**Start Incision**
Splitting or dividing Pectoralis Major			**Start Dissection**
Divides Pectoralis Minor			
Correctly identifies Axillary Artery			
Correctly identifies Axillary Vein			
Correctly identifies brachial plexus			
Controls the Axillary Artery Proximal to injury			**Finish**
Error: Incorrectly identifies the Axillary artery and does not recognize or correct error			
Error: Incorrectly identifies the Axillary Artery but is able to recognize and correct			

Technique points

	Score 1-5
*Exposes arteries by dissecting directly on anterior surface**	
*Manipulates artery by grasping adventitia**	
Uses instruments properly	
Positions body to use instruments to best advantage	
Proceeds at appropriate pace with economy of movement	
Handles tissue well with minimal damage	
Creates an adequate visual field for procedure	
Communicates clearly and consistently	
Performs procedure without unnecessary dissection	
Continually progresses towards the end goal	

(5) Every time/Excellent; (4) Almost every time/Very good; (3) Sometimes/Good; (2) Rarely/Fair; (1) Never/Poor

*N/A for model

Expert Discriminator Operative Field Maneuvers for Axillary Artery Exposure

	Yes	No
Operates through 'key-hole' or too small a skin incision		
Operates using full incision		
Excessive dissection		
Pointless digging and shifting around in surgical field		
Has a logical operating sequence		
Lacks anatomical knowledge		

Expert Discriminatory Instrument Use for Axillary Artery Exposure

	Yes	No
Improper instrument use (e.g. back-handed use)		
Incorrect instrument holding (e.g. forceps too near tips, thumb through scissors handle)		
Scalpel use: multiple tentative cuts or cuts tangentially		
Switches instruments more than you would		
Uses scissors less than you would		
Dedicated use of a single instrument.		

Questions in OR, after dissection:

What are the consequences of ligating the axillary artery?

The participant answered the questions correctly:		
	Yes	No
Ligation of the axillary generally does not cause ischemia due to extensive collaterals around the shoulder.		

What are the pitfalls or common errors that one might expect with this procedure?

Possible Answers		
	Yes	No
Incision – too high, too low		
Iatrogenic injury to nerve, artery, vein		
Inability to get proximal control – needing to go above clavicle or into chest		
Diving into clot or hematoma without adequate control		
Mistaking nerve for artery		

AXILLARY ARTERY EXPOSURE GLOBAL RATING (circle one)**:**

Technical Skills for Exposing the Axillary Artery:

1	2	3	4	5
The participant's technical skills were poor with much wasted moves and very poor tissue handling.	The participant demonstrated fair technical skills with some wasted movements and errors in tissue handling	The participant demonstrated good technical skills with occasional wasted movements and errors in tissue handling.	The participant demonstrated very good technical skills with minimal wasted movements and errors in tissue handling.	The participant demonstrated excellent technical skills with no wasted movements and proper respect for tissues.

Overall Understanding of the Evaluation and Treatment of a Patient with a Suspected Axillary Artery Injury:

1	2	3	4	5
Core knowledge is poor and there is no evidence of understanding the nuances of evaluation and diagnosis.	Core knowledge is fair with some understanding of the nuances of evaluation and diagnosis.	Core knowledge is good with moderate understanding of the nuances of evaluation and diagnosis.	Core knowledge is very good with thorough understanding of the nuances of evaluation and diagnosis.	Core knowledge is excellent with a superior understanding of the nuances of evaluation and diagnosis.

Overall Understanding of the Surgical Anatomy of the Axillary Region:

1	2	3	4	5
Poor knowledge of the regional anatomy. Unable to identify major structures or their relationships.	Fair knowledge of regional anatomy. Can name some of the major structures and their relationships	Good understanding of the anatomy. Can name most of the major structures and their relationships.	Very good understanding of anatomy. Able to point out all of the major structures and their relationships.	Excellent understanding of the anatomy, including variants. Knows the minutia, Should be teaching anatomy class.

This participant is ready to perform exposure and control the Axillary Artery:

1	2	3	4	5
Take me to another hospital please!	This participant could do the exposure fine with experienced help, but will struggle if left alone.	The participant might need to look at a text to refresh their memory but will be able to perform the exposure.	This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.	Absolutely, I hope that this individual is on call if I am injured.

Evaluator's overall rating (1-100) _____

≥ 90 Excellent I hope that this individual is on call if I am injured
80-89 This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.
70-79 The participant might need to look at a text to refresh their memory but will be able to perform the exposure
60-69 This participant could do the exposure with experienced help, but will struggle if left alone
<60 Take me to another hospital please!

The overall score should be the instructor's subjective rating of how well the surgeon performed. This will be compared to the objective score for the purpose of validating the scoring method.

Body Habitus of cadaver (Circle):

Obese Average Thin

Cadaver Anatomy (Circe):

Normal Variant

Name of Evaluator: **Date:**

Name of Candidate: **(Circle timing): Pre Post**

1st Trial

Circle type of trial: Cadaver / Model

Case Two: Brachial Artery

Case Presentation

- **32 y/o male was accidentally shot in the arm at close range with a hunting rifle.**
- **He was reported to have had large pulsatile blood loss at the scene.**

[Advance slide to show image of wound]
[Advance slide to continue narrative]

- **There is active pulsatile bleeding from the medial wound which is currently being controlled with direct pressure by the paramedic.**
- **Distal pulses are absent.**
- **BP = 100/68, HR = 120**
- **There are no other injuries.**

Question #1:

What are the structures you suspect could be injured, including nerve, artery, vein, or other?

Expected Answers checklist:

The participant described each of the following as potentially injured:		
	Yes	**No**
Brachial Artery		
Median Nerve		
Radial Nerve		
Humerus		
Radius, Ulna		
Veins		

BP is 105/70 and HR is 110. The patient has no neurologic deficit, but has absent radial and ulnar pulses.

Question #2:

What additional studies would you perform to help you identify or rule out specific injuries in this patient?

Expected Answers checklist:

The participant described each of the following as additional studies		
	Yes	**No**
X-ray of arm		
Chest X-ray		
CT Angiogram (zero pts)		
Angiogram (zero points)		
Error: Inappropriate use of CT or Angio*		

All of the above tests are acceptable possible studies but the participant should clearly indicate these tests should only be done in a hemodynamically stable patient. Without this qualifier, performing any of these tests prior to taking this patient to the OR has potential for negative outcome & should result in negative value scoring.

***Scoring Note: no additional points are added for additional studies**

Arm X-ray shows no fracture and no retained fragments. Chest X-ray is normal (if ordered).

Question #3:

What is your plan for this patient?

If the participant persists in suggesting a non-operative course – they should be informed that **"the patient is now in the operating room."**

Expected Answers checklist:

The participant states the following plan		
	Yes	**No**
Patient should be taken urgently to the Operating room		
Error: Delay in going to the operating room		

The Patient has now been transported to the Operating Room and is on the OR table in front of you.

Question OR # 1:

How would you position and prep this patient in order to repair this injury and explain why you chose to prep as you did?

Expected Answers checklist:

The participant Indicates the following in response:		
	Yes	**No**
The patient should be supine		
The arm extended on an arm board		

The prep should include:		
The entire arm and hand on the affected side		
Mentions need to evaluate perfusion to the hand		
The Axilla on the affected side		
Mentions possible need to expose axillary artery for proximal control		
The thigh/groin for possible vein harvest		
Error: Fails to prep entire arm and hand.		
Error: Fails to prep the thigh for vein harvest		

Question OR # 2:

Can you describe how you plan to gain control of the bleeding vessel using general principles of vascular surgery?

Expected Answers checklist:

The participant indicates the following principles of vascular exposure:		
	Yes	**No**
Proximal control first		
Distal control second		
Expose injury		

Question OR # 3:

At this time, please describe and then mark on the skin the landmarks and the incision that you plan to use.

Expected Answers checklist:

The participant Indicates and marks the following landmarks:		
	Yes	**No**
The biceps and triceps		
The humerus		
Incision between biceps and triceps bellies		

EXPOSURE OF BRACHIAL ARTERY

"Now I would like you to surgically expose and control the Brachial Artery with a vessel loop in order to gain proximal control. As you operate, speak out loud and identify each step of the procedure. It is not necessary to rush through the procedure. The procedure will be deemed complete once you have placed a vessel loop around the Brachial artery to obtain proximal control. Do you have any questions? If not please proceed"

Expected operative dissection performance checklist:

The participant describes and performs each of the following steps:			
	Yes	**No**	**Time**
Initial skin incision is adequate to perform exposure			**Start Incision**
Creates a plane of dissection between the Biceps and Triceps			**Start Dissection**
Correctly identifies Median Nerve			
Retracts and protects Median Nerve			
Correctly identifies Brachial Artery			
Dissects Brachial Artery away from venae comites			
Controls Brachial artery with vessel loop proximal to the injury			**Finish**
Error: Incorrectly identifies the Brachial Artery and does not recognize or correct error			
Error: Incorrectly identifies the Brachial Artery but is able to recognize and correct			

Technique points

	Score 1-5
*Exposes arteries by dissecting directly on anterior surface**	
*Manipulates artery by grasping adventitia**	
Uses instruments properly	
Positions body to use instruments to best advantage	
Proceeds at appropriate pace with economy of movement	
Handles tissue well with minimal damage	
Creates an adequate visual field for procedure	
Communicates clearly and consistently	
Performs procedure without unnecessary dissection	
Continually progresses towards the end goal	

(5) Every time/Excellent; (4) Almost every time/Very good; (3) Sometimes/Good; (2) Rarely/Fair; (1) Never/Poor

*N/A for model

Expert Discriminator Operative Field Maneuvers for Brachial Artery Exposure

	Yes	No
Operates through 'key-hole' or too small a skin incision		
Operates using full incision		
Excessive dissection		
Pointless digging and shifting around in surgical field		
Has a logical operating sequence		
Lacks anatomical knowledge		

Expert Discriminatory Instrument Use for Brachial Artery Exposure

	Yes	No
Improper instrument use (e.g. back-handed use)		
Incorrect instrument holding (e.g. forceps too near tips, thumb through scissors handle)		
Scalpel use: multiple tentative cuts or cuts tangentially		
Switches instruments more than you would		
Uses scissors less than you would		
Dedicated use of a single instrument.		

Questions in OR, after dissection:

What are the consequences of ligating the brachial artery?

The participant answered the questions correctly:		
	Yes	No
Can ligate the brachial artery: ligation above the profunda results in limb loss in 50% of cases; below the profunda results in limb loss in 5% of cases		

What are the pitfalls or common errors that one might expect with this procedure?

Possible Answers		
	Yes	No
Incision – too anterior, too posterior		
Mistaking nerve for artery		
Iatrogenic injury to nerve, artery, vein		
Diving into clot or hematoma at the injury site without adequate control		

BRACHIAL ARTERY EXPOSURE GLOBAL RATING (circle one)**:**

Technical Skills for Exposing the Brachial Artery:

1	2	3	4	5
The participant's technical skills were poor with much wasted moves and very poor tissue handling.	The participant demonstrated fair technical skills with some wasted movements and errors in tissue handling	The participant demonstrated good technical skills with occasional wasted movements and errors in tissue handling.	The participant demonstrated very good technical skills with minimal wasted movements and errors in tissue handling.	The participant demonstrated excellent technical skills with no wasted movements and proper respect for tissues.

Overall Understanding of the Evaluation and Treatment of a Patient with a Patient with a suspected Brachial Artery Injury:

1	2	3	4	5
Core knowledge is poor and there is no evidence of understanding the nuances of evaluation and diagnosis.	Core knowledge is fair with some understanding of the nuances of evaluation and diagnosis.	Core knowledge is good with moderate understanding of the nuances of evaluation and diagnosis.	Core knowledge is very good with thorough understanding of the nuances of evaluation and diagnosis.	Core knowledge is excellent with a superior understanding of the nuances of evaluation and diagnosis.

Overall Understanding of the Surgical Anatomy of the Arm:

1	2	3	4	5
Poor knowledge of the regional anatomy. Unable to identify major structures or their relationships.	Fair knowledge of regional anatomy. Can name some of the major structures and their relationships	Good understanding of the anatomy. Can name most of the major structures and their relationships.	Very good understanding of anatomy. Able to point out all of the major structures and their relationships.	Excellent understanding of the anatomy, including variants. Knows the minutia, Should be teaching anatomy class.

This Participant is Ready to Perform Exposure and Control of the Brachial Artery and its Branches:

1	2	3	4	5
Take me to another hospital please!	This participant could do the exposure fine with experienced help, but will struggle if left alone.	The participant might need to look at a text to refresh their memory but will be able to perform the exposure.	This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.	Absolutely, I hope that this individual is on call if I am injured.

Evaluator's overall rating (1-100) _____

≥ 90 Excellent I hope that this individual is on call if I am injured
80-89 This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.
70-79 The participant might need to look at a text to refresh their memory but will be able to perform the exposure
60-69 This participant could do the exposure with experienced help, but will struggle if left alone
<60 Take me to another hospital please!

The overall score should be the instructor's subjective rating of how well the surgeon performed. This will be compared to the objective score for the purpose of validating the scoring method.

Body Habitus of cadaver (Circle):

Obese Average Thin

Cadaver Anatomy (Circe):

Normal Variant

Name of Evaluator: **Date:**

Name of Candidate: **(Circle timing): Pre Post**

1st Trial

Circle type of trial: Cadaver / Model

Case Three: Femoral Artery

Case History:

- **24 y/o male who was a victim of a drive by shooting, sustaining a through and through gunshot wound to the Right/Left mid-thigh**
- **He was reported to have a large amount of bright red pulsatile blood at the scene**
- **He was initially taken to a small community hospital without an in-house surgeon where his blood pressure was 80/50 and his heart rate was 140. He was reported to have a markedly swollen thigh with active bleeding and no distal pulses. There are no other injuries.**

[Advance slide to show image of wound]

[Advance slide to continue narrative]

- **At the outside hospital a tourniquet was placed and he received 3000 cc of crystalloid. He is transferred to your facility now more than four hours after the injury. He received low dose norepinephrine and has a blood pressure of 100/70 and a HR of 130, with a markedly swollen thigh and absent distal pulses.**

Question #1:

What are all the structures you suspect could be injured, including nerve, artery, vein, or other structure?

Expected Answers checklist:

The participant described each of the following as potentially injured:		
	Yes	**No**
Common Femoral Artery		
Common Femoral Vein		
Superficial Femoral Artery		
Superficial Femoral Vein		
Femoral Nerve/Branches		
Profunda Femoral Artery		
Femur		

Question #2:

What are the physical findings that may help you determine which structures are injured in this patient, including signs of vascular, nerve, and bone injury?

Expected Answers checklist:

The participant describes each of the following physical findings and tests:		
	Yes	**No**
Loss of Popliteal/DP/PT pulses		
Pulsatile bleeding		
Expanding hematoma		
Hemorrhagic shock		
Unstable femur or crepitance of bone		
Ankle-Ankle or Ankle-Brachial Index		
Neurologic deficits in femoral nerve distribution:		
Sensation to anterior thigh		
Motor to hip flexion, knee extension		

BP is 95/65 and HR is 125. The patient has a cool and pulseless foot, he is able to move the ankle and foot, but is unable to extend the knee. There is numbness on the anterior thigh.

Question #3:

What additional studies would you perform to help you identify or rule out specific injuries in this patient?

Expected Answers checklist:

The participant described each of the following as additional studies		
	Yes	**No**
X-ray of femur		
Chest X-ray (zero points)		
CT Angiogram (zero pts)		
Angiogram (zero points)		
Error: Inappropriate use of CT or Angio*		

All of the above tests are acceptable possible studies but the participant should clearly indicate these tests <u>should only be done in a hemodynamically stable patient</u>. Without this qualifier, performing any of these tests prior to taking this patient to the OR has potential for negative outcome & should result in negative value scoring.

***Scoring Note: no additional points are added for additional studies**

The femoral X-ray shows no fracture and no retained fragments. Chest X-ray is normal (if obtained).

If Sup Femoral artery injury has not been recognize—Tell the participant explicitly that the patient has an injury to the Superficial Femoral Artery.

Question #4:
What is your plan for this patient?

FYI: If the participant persists in suggesting a non-operative course – **Inform the participant that the patient is now in the operating room and needs exposure and control of the Femoral Artery.**

Expected Answers checklist:

The participant states the following plan		
	Yes	**No**
Patient should be taken urgently to the Operating room		
Error: Delay in going to the operating room		

Question #5:

What interventions are important to resuscitate and treat this patient before and during surgery?

Question #6:

What further management would you consider given the ischemic time which is already greater than 4 hours?

Expected Answers checklist:

The participant describes each of the following additional items the patient might receive:		
	Yes	**No**
Hemorrhagic Shock:		
Resuscitate with blood products		
Transfuse with high ratio of blood:FFP:platelets/ Massive transfusion protocol		
Wean off norepinephrine		
Minimize crystalloid		
Give TXA		
Reperfusion injury:		
Volume load		
Bicarbonate		
Monitor for arrhythmia		
Already lengthy ischemic time:		
Temporary vascular shunt		
Recognize need for fasciotomy		
Monitor for rhabdomyolysis		

The patient has now been transported to the Operating Room and is on the OR table in front of you.

Question OR # 1:

How would you position and prep this patient in order to repair this injury and explain why you chose to prep as you did?

Expected Answers checklist:

The participant Indicates the following in response:		
	Yes	**No**
The patient should be supine		
Leg externally rotated and knee supported		

The prep should include:		
The entire lower extremity, including foot on the affected side		
States need to assess perfusion to the foot		
States possible need for fasciotomy		
The thigh/groin on the contralateral side for possible vein harvest		
Error: Fails to prep entire lower extremity, including foot on effected side		
Error: Fails to prep the contralateral groin		

Question OR # 2:

At this time, please verbalize and then mark on the cadaver the landmarks and the incision that you will use on the skin.

Expected Answers checklist:

The participant Indicates and marks the following landmarks		
	Yes	**No**
Pubic tubercle		
Ant Sup iliac Spine (ASIS)		
Inguinal ligament		
Femoral artery (approximate location 1/3 of distance from pubic tubercle to ASIS)		
Marks longitudinal incision over femoral artery, 2 finger breadths lateral to the pubic tubercle		
Incision extends above inguinal ligament 4-5 cm		

EXPOSURE OF FEMORAL ARTERY

"At this time, I would like you to surgically explore and control the Common Femoral Artery, the Superficial Femoral Artery, and Profunda Femoral Artery. As you operate, speak out loud and identify each step of the procedure. It is not necessary to rush through the procedure. The procedure will be deemed complete once you have placed a double vessel loop around the Common Femoral, Superficial Femoral, and Profunda Femoral arteries to obtain proximal control. Do you have any questions? If not please proceed."

Expected operative dissection performance checklist:

The participant describes and performs each of the following steps:			
	Yes	**No**	**Time**
Initial skin incision is adequate to perform exposure			**Start Incision**
Correctly identifies Common Femoral Artery			**Start Dissection**
Correctly identifies Common Femoral Vein			
Correctly identifies Profunda Femoral Branch			
Correctly identifies Superficial Femoral Artery			
Controls Common Femoral Artery with vessel loop			
Controls Profunda Femoral Artery with vessel loop			
Controls Superficial Femoral Artery with vessel loop			**Finish**
Error: Incorrectly identifies the CFA, SFA, or PFA and does not recognize or correct error			
Error: Incorrectly identifies CFA, SFA, or PFA, but is able to recognize and correct			

Technique points

	Score 1-5
*Exposes arteries by dissecting directly on anterior surface**	
*Manipulates artery by grasping adventitia**	
Uses instruments properly	
Positions body to use instruments to best advantage	
Proceeds at appropriate pace with economy of movement	
Handles tissue well with minimal damage	
Creates an adequate visual field for procedure	
Communicates clearly and consistently	
Performs procedure without unnecessary dissection	
Continually progresses towards the end goal	

(5) Every time/Excellent; (4) Almost every time/Very good; (3) Sometimes/Good; (2) Rarely/Fair; (1) Never/Poor

*N/A for model

Expert Discriminator Operative Field Maneuvers for Femoral Artery Exposure

	Yes	No
Operates through 'key-hole' or too small a skin incision		
Operates using full incision		
Excessive dissection		
Pointless digging and shifting around in surgical field		
Has a logical operating sequence		
Lacks anatomical knowledge		

Expert Discriminatory Instrument Use for Femoral Artery Exposure

	Yes	No
Improper instrument use (e.g. back-handed use)		
Incorrect instrument holding (e.g. forceps too near tips, thumb through scissors handle)		
Scalpel use: multiple tentative cuts or cuts tangentially		
Switches instruments more than you would		
Uses scissors less than you would		
Dedicated use of a single instrument.		

Questions in OR, after dissection:

What are the consequences of ligating the Superficial Femoral artery? What are the consequences of ligating the Superficial Femoral vein?

The participant answered the questions correctly:		
	Yes	No
SFA results in severe limb ischemia /requires amputation		
SFV ligation may cause limb edema		

What are the pitfalls or common errors that one might expect with this procedure?

Possible Answers		
	Yes	No
Incision – too high, too low		
Iatrogenic injury to nerve, artery, vein		
Inability to get proximal control below the inguinal ligament		
Diving into clot or hematoma at the injury site without adequate proximal and distal control		
Mistaking nerve for artery		
Variable location of Profunda Femoral Artery or mistaking SFA for CFA		

FEMORAL ARTERY EXPOSURE GLOBAL RATING (circle one)**:**

Technical Skills for Exposing Common Femoral Artery and Branches:

1	2	3	4	5
The participant's technical skills were poor with much wasted moves and very poor tissue handling.	The participant demonstrated fair technical skills with some wasted movements and errors in tissue handling	The participant demonstrated good technical skills with occasional wasted movements and errors in tissue handling.	The participant demonstrated very good technical skills with minimal wasted movements and errors in tissue handling.	The participant demonstrated excellent technical skills with no wasted movements and proper respect for tissues.

Overall Understanding of the Evaluation and Treatment of a Patient with a Suspected Superficial Femoral Artery Injury:

1	2	3	4	5
Core knowledge is poor and there is no evidence of understanding the nuances of evaluation and diagnosis.	Core knowledge is fair with some understanding of the nuances of evaluation and diagnosis.	Core knowledge is good with moderate understanding of the nuances of evaluation and diagnosis.	Core knowledge is very good with thorough understanding of the nuances of evaluation and diagnosis.	Core knowledge is excellent with a superior understanding of the nuances of evaluation and diagnosis.

Overall Understanding of the Surgical Anatomy of the Inguinal Region:

1	2	3	4	5
Poor knowledge of the regional anatomy. Unable to identify major structures or their relationships.	Fair knowledge of regional anatomy. Can name some of the major structures and their relationships	Good understanding of the anatomy. Can name most of the major structures and their relationships.	Very good understanding of anatomy. Able to point out all of the major structures and their relationships.	Excellent understanding of the anatomy, including variants. Knows the minutia, Should be teaching anatomy class.

This Participant is ready to Perform Exposure and Control the Common Femoral Artery and Branches:

1	2	3	4	5
Take me to another hospital please!	This participant could do the exposure fine with experienced help, but will struggle if left alone.	The participant might need to look at a text to refresh their memory but will be able to perform the exposure.	This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.	Absolutely, I hope that this individual is on call if I am injured.

Evaluator's overall rating (1-100) _____

≥ 90 Excellent I hope that this individual is on call if I am injured
80-89 This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.
70-79 The participant might need to look at a text to refresh their memory but will be able to perform the exposure
60-69 This participant could do the exposure with experienced help, but will struggle if left alone
<60 Take me to another hospital please!

The overall score should be the instructor's subjective rating of how well the surgeon performed. This will be compared to the objective score for the purpose of validating the scoring method.

Body Habitus of cadaver (Circle):

Obese Average Thin

Cadaver Anatomy (Circe):

Normal Variant

Name of Evaluator: **Date:**

Name of Candidate: **(Circle timing): Pre Post**

1st Trial

Circle type of trial: Cadaver / Model

Case Four: Fasciotomy

If the participant did not recognize or state the need for fasciotomy in the last case, they should be informed that the patient will need one and that they will be asked to perform it after a brief discussion/review of their understanding of the indications, pathophysiology, anatomy and steps of the procedure.

Case Presentation:

- **In the previous case you got proximal control of the femoral artery at the groin and with further dissection discovered an injury to the SFA and SFV in the mid-thigh, which you elected to shunt due to the patient's physiology.**
- **It is now nearly 5 ½ hours after the injury and you have indicated (been told) that this patient requires a fasciotomy given the high likelihood that he might develop compartment syndrome of the lower leg.**

Question #1:

Please describe exactly what compartment syndrome is and the consequences of not treating it.

Expected Answers checklist:

The participant is able to describe each of the following:		
	Yes	**No**
Compartment syndrome results from increased pressure within the defined compartments		
Increasing pressure within the compartment results in decreased tissue perfusion with ischemia and eventual death of nerve and muscle		
Pressure can increase in the compartment by increasing its contents (swelling)		
Pressure can increase in the compartment by restricting its volume (external compression)		
If untreated, nerve and muscle will die with disability / limb loss		
Untreated compartment syndrome may result in rhabdomyolsyis /kidney failure and possible death		

Question #2:

What type of injuries and non-traumatic causes are associated with the development of compartment syndrome of the lower extremity? Include causes of internal and external pressure.

Expected Answers checklist:

The participant is able to describe each of the following:		
	Yes	**No**
Fracture		
States open fracture is more likely to cause compartment syndrome than closed		
Vascular injury with prolonged ischemia		
Crush Injury		
Blast Injury		
External compression – Cast, constrictive dressing, burn eschar		
Thrombus or embolic event		
Massive fluid resuscitation		
IV infiltration		
Muscle overuse - athletes		
Snake bite or bee sting		
Hemorrhage into compartment (sickle cell, hemophilia, anticoagulants)		

Question #3

- How many compartments are in the leg?

- What are the names of the compartments?

Expected Answers checklist:

The participant describes or understands each of the following:		
	Yes	**No**
There are four Compartments in the lower leg		
Anterior Compartment		
Lateral Compartment		
Superficial Posterior Compartment		
Deep Posterior Compartment		

Question #4.

- What are the physical findings and symptoms that indicate a diagnosis of compartment syndrome in the lower leg?

- Which occur early?

- What tests can help diagnose compartment syndrome?

- When would you measure compartment pressures to help diagnose compartment syndrome?

- What compartment pressure would indicate compartment syndrome?

Expected Answers checklist:		
The participant is able to describe each of the following:		
	Yes	**No**
Relates concept that one should have a low index of suspicion for making Dx		
The five Ps: - **Pain** - **Parasthesias** - **Pallor/Pokilothermia** - **Pulslessness** - **Paralysis** Check "yes" if 3-4 correct or 5 correct	**3-4/5** **5/5**	
Limb may feel tense or hard		
States that waiting for the 5 Ps to occur is waiting too long		
Earliest sign is pain out of proportion to injury (pain with passive toe stretch)		
Loss of sensation in web space between 1st two toes		
May check compartment pressures to help with diagnosis		
Trend of myoglobin or CPK may help with diagnosis		
Check compartment pressures if exam is unreliable (drugs, head injury, paraplegia etc)		
Compartment pressure over 30 mmHg is consistent with compartment syndrome (may use up to 45 mmHg if relate controversy)		
Delta P (Diastolic BP – compartment pressure) <30 is another way to diagnose compartment syndrome		
Measuring compartment pressures can be inaccurate, so need high clinical suspicion		

You are now in the OR with the patient.

Question OR # 1:
At this time, please describe and then mark on the skin the landmarks and the incision that you plan to use.

Inform participant to mark both medial and lateral incisions before proceeding

Expected Answers checklist:

The participant Indicates and marks the following landmarks:		
	Yes	**No**
Patella		
Tibial Spine		
Tibial tuberosity/plateau		
Fibular Head		
Lateral Malleolus		
Course of Fibula		
Medial Edge of Tibia		
Medial Malleolus		

LATERAL leg incision landmarks:		
	Yes	**No**
The lateral Incision is marked one-two fingers in front of the fibula (1.5-3.0 cm)		
Upper end of incision 2-3 fingers (3.0-6.0 cm) from tibial plateau (TP)		
Lower end of incision 2-3 fingers (3.0-6.0 cm) from Lat. malleolus		

MEDIAL leg incision landmarks:		
	Yes	**No**
The Medial Incision is marked one Thumb behind the tibia (1.0-3.0 cm)		
Upper end of incision 2-3 fingers (3.0-6.0 cm) from tibial plateau (TP)		
Lower end of incision 2-3 fingers (3.0-6.0 cm) from Med. malleolus		

Now I would like you to perform the lower extremity fasciotomy. As you operate, speak out loud and identify each step of the procedure. It is not necessary to rush through the procedure—you should operate at a comfortable pace. The procedure will be deemed complete once you have decompressed all four compartments. Do you have any questions? If not please proceed.

Expected operative dissection performance checklist:

LATERAL leg incision:		
Start Incision	**Time:**	
	Yes	**No**
Identifies Intermuscular septum / correctly identifies anterior and lateral compartments		
Mentions perforating vessels as way to find IM septum		
Uses "H-Shaped" incision to open fascia		
Under-runs fascia with closed scissor tips		
Opens fascia with partially closed scissor tips		
Points tips of scissors away from septum		
Relates necessity to avoid injury to underlying nerves		
Opens fascia over anterior compartment completely, within 3 cm of fibular head and lateral maleolus		
Opens fascia over lateral compartment completely		
Finish Incision	**Time:**	

MEDIAL leg incision:		
Start Incision	**Time:**	
	Yes	**No**
Identifies and relates need to preserve greater saphenous vein and to ligate tributaries		
Correctly identify superficial posterior compartment (SPC)		
Opens entire length of fascia over superficial post compartment, within 3 cm of tibial plateau and medial maleolus		
Takes down soleus fibers from underside of tibia to enter Deep Post Compartment (DPC)		
Identifies the neurovascular bundle in the DPC		
Finish Incision	**Time:**	

Error: Incorrectly identifies the intermuscular septum, does not recognize or correct error/ fails to decompress Ant Comp	
Error: Incorrectly identifies the intermuscular septum, but is able to recognize and correct	
Error: Fails to open compartments along the entire length	
Error: Fails to identify the deep posterior compartment	

Technique points

	Score 1-5
Uses instruments properly	
Positions body to use instruments to best advantage	
Proceeds at appropriate pace with economy of movement	
Handles tissue well with minimal damage	
Creates an adequate visual field for procedure	
Communicates clearly and consistently	
Performs procedure without unnecessary dissection	
Continually progresses towards the end goal	

(5) Every time/Excellent; (4) Almost every time/Very good; (3) Sometimes/Good; (2) Rarely/Fair; (1) Never/Poor

Expert Discriminator Operative Field Maneuvers for a lower extremity Fasciotomy

	Yes	No
Operates through 'key-hole' or too small a skin incision		
Operates using full incision		
Excessive dissection		
Pointless digging and shifting around in surgical field		
Has a logical operating sequence		
Lacks anatomical knowledge		

Expert Discriminatory Instrument Use for a lower extremity Fasciotomy

	Yes	No
Improper instrument use (e.g. back-handed use)		
Incorrect instrument holding (e.g. forceps too near tips, thumb through scissors handle)		
Scalpel use: multiple tentative cuts or cuts tangentially		
Switches instruments more than you would		
Uses scissors less than you would		
Dedicated use of a single instrument.		

Questions in OR, after dissection:

What are the pitfalls or common errors that one might expect with this procedure?

Possible Answers		
	Yes	No
Not making or delaying the diagnosis of Compartment syndrome		
Performing an incomplete fasciotomy		
Missing the anterior compartment		
Missing the deep posterior compartment		
Making inadequate skin incisions		
Injury to nerve/artery/vein		

LOWER EXTREMITY FASCIOTOMY GLOBAL RATING (circle one)**:**

Technical Skills Displayed by participant during Fasciotomy:

1	2	3	4	5
The participant's technical skills were poor with much wasted moves and very poor tissue handling.	The participant demonstrated fair technical skills with some wasted movements and errors in tissue handling	The participant demonstrated good technical skills with occasional wasted movements and errors in tissue handling.	The participant demonstrated very good technical skills with minimal wasted movements and errors in tissue handling.	The participant demonstrated excellent technical skills with no wasted movements and proper respect for tissues.

Overall Understanding of the of How to make the Diagnosis of Compartment Syndrome:

1	2	3	4	5
Core knowledge is poor and there is no evidence of understanding the nuances of evaluation and diagnosis.	Core knowledge is fair with some understanding of the nuances of evaluation and diagnosis.	Core knowledge is good with moderate understanding of the nuances of evaluation and diagnosis.	Core knowledge is very good with thorough understanding of the nuances of evaluation and diagnosis.	Core knowledge is excellent with a superior understanding of the nuances of evaluation and diagnosis.

Overall Understanding of the Surgical Anatomy required for performing Fasciotomy of the Lower Extremity:

1	2	3	4	5
Poor knowledge of the regional anatomy. Unable to identify major structures or their relationships.	Fair knowledge of regional anatomy. Can name some of the major structures and their relationships	Good understanding of the anatomy. Can name most of the major structures and their relationships.	Very good understanding of anatomy. Able to point out all of the major structures and their relationships.	Excellent understanding of the anatomy, including variants. Knows the minutia, Should be teaching anatomy class.

This Participant is Ready to Perform a Two-Incision Four-Compartment Fasciotomy of the Lower Extremity:

1	2	3	4	5
Take me to another hospital please!	This participant could do the exposure fine with experienced help, but will struggle if left alone.	The participant might need to look at a text to refresh their memory but will be able to perform the exposure.	This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.	Absolutely, I hope that this individual is on call if I am injured.

Overall Understanding of the Etiology and Pathophysiology of Compartment syndrome of the Lower Extremity:

1	2	3	4	5
The participant has a poor understanding.	The participant has a fair understanding.	The participant has a good understanding.	The participant has a very good understanding.	The participant has an excellent understanding.

Evaluator's overall rating (1-100) _____

≥ 90 Excellent I hope that this individual is on call if I am injured
80-89 This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.
70-79 The participant might need to look at a text to refresh their memory but will be able to perform the exposure
60-69 This participant could do the exposure with experienced help, but will struggle if left alone
<60 Take me to another hospital please!

The overall score should be the instructor's subjective rating of how well the surgeon performed. This will be compared to the objective score for the purpose of validating the scoring method.

Body Habitus of cadaver (Circle):

Obese Average Thin

Cadaver Anatomy (Circe):

Normal Variant

Appendix 9: Script Slides

Please see digital file of the same name

Appendix 10: Video Evaluation sheet

9 pages

Appendix 11: Cadaver vs Live patient questionnaire

Cadaver Upper Extremity Realism Feedback

Compared to a live patient, please score the cadaver upper extremity on a scale of 1 to 5

	1= No reality				5 = Very realistic
Skin	1	2	3	4	5
Subcutaneous tissue	1	2	3	4	5
Muscle	1	2	3	4	5
Fascia	1	2	3	4	5
Vasculature	1	2	3	4	5
Usefulness for Training	1	2	3	4	5
Realism for training	1	2	3	4	5
Anatomic reality	1	2	3	4	5

For the cadaver upper extremity, please provide feedback on the following:

What are the strengths of the model?

What are the weaknesses?

Did you find anything about the model distracting?

Do you have suggestions for improvement?

Any other comments?

Cadaver Lower Extremity Realism Feedback

Compared to a live patient, please score the cadaver lower extremity on a scale of 1 to 5

	1= No reality				5 = Very realistic
Skin	1	2	3	4	5
Subcutaneous tissue	1	2	3	4	5
Muscle	1	2	3	4	5
Fascia	1	2	3	4	5
Vasculature	1	2	3	4	5
Usefulness for Training	1	2	3	4	5
Realism for training	1	2	3	4	5
Anatomic reality	1	2	3	4	5

For the cadaver lower extremity, please provide feedback on the following:

What are the strengths of the model?

What are the weaknesses?

Did you find anything about the model distracting?

Do you have suggestions for improvement?

Any other comments?

Appendix 12: Physical Model Realism questionnaire

Cadaver Upper Extremity Realism Feedback

Compared to a live patient, please score the cadaver upper extremity on a scale of 1 to 5

	1= No reality				5 = Very realistic
Skin	1	2	3	4	5
Subcutaneous tissue	1	2	3	4	5
Muscle	1	2	3	4	5
Fascia	1	2	3	4	5
Vasculature	1	2	3	4	5
Usefulness for Training	1	2	3	4	5
Realism for training	1	2	3	4	5
Anatomic reality	1	2	3	4	5

For the cadaver upper extremity, please provide feedback on the following:

What are the strengths of the model?

What are the weaknesses?

Did you find anything about the model distracting?

Do you have suggestions for improvement?

Any other comments?

Cadaver Lower Extremity Realism Feedback

Compared to a live patient, please score the cadaver lower extremity on a scale of 1 to 5

	1= No reality				5 = Very realistic
Skin	1	2	3	4	5
Subcutaneous tissue	1	2	3	4	5
Muscle	1	2	3	4	5
Fascia	1	2	3	4	5
Vasculature	1	2	3	4	5
Usefulness for Training	1	2	3	4	5
Realism for training	1	2	3	4	5
Anatomic reality	1	2	3	4	5

For the cadaver lower extremity, please provide feedback on the following:

What are the strengths of the model?

What are the weaknesses?

Did you find anything about the model distracting?

Do you have suggestions for improvement?

Any other comments?

Appendix 13: Demographic and surgical comfort level questionnaire

2 pages, put page numbers in file

2nd page

Appendix 14: Abstract for ASSET historical data for presentation at FASEB 2014

The assets of ASSET: Improving surgical performance confidence through an anatomy and skills review course for surgeons

Evan M Garofalo[1], Stacy Shackelford[1,2], Megan A Holmes[1,3], Colin Mackenzie[1], Mark W Bowyer[4].
[1]University of Maryland, Baltimore, MD, [2]C-STARS, Baltimore, MD, [3]Johns Hopkins University, [4]USUHS, Bethesda, MD

Rapid control of major hemorrhage is a primary goal in trauma surgery. However, many surgeons have little practical experience with the required vascular exposures. To address this, the American College of Surgeons developed the Advanced Surgical Skills for Exposure in Trauma (ASSET) course to review anatomy, skills and techniques for major vascular exposures. Since 2008, a broad range of participants have attended, including surgeons of many specialties, deploying military surgeons and surgery residents.

We compared self-reported confidence of participants (n=562) in surgical tasks (n=47) at baseline and directly after ASSET training to examine the effect of the course stratified by surgical experience level (resident/fellow; <8 years post-residency; 8+ years post-residency), specialty (trauma/vascular; general surgery; other specialties), and body region.

Results of Freeman-Halton 3x2 tests indicated significant gains in confidence scores for all specialties ($p<0.02$), particularly for general surgeons ($p<0.01$) and exposures in the chest ($p<0.001$), after ASSET. There was no difference in confidence gained by surgical experience. This study demonstrates the value of continuing education in applied anatomy for clinical practice. Given the frequency of vascular trauma in current military conflicts, the impact of ASSET is particularly relevant for preparing deploying surgeons for the theatre.

Appendix 15: Abstract for ACS, Expert vs Novice video review

Development of a Surgical Skills Assessment Method for Trauma

Stacy Shackelford, MD, FACS, Evan Garofalo, PhD, Megan Holmes, BS, Hegang Chen PhD, Mark Bowyer, MD, FACS , Sharon Henry, MD, FACS, Babak Sarani, MD, FACS, Jason Pasley, MD, Colin Mackenzie, MBChB

Background: With limits on residency training hours and decrease in penetrating trauma nationally, surgical experience with managing traumatic hemorrhage has declined. An objective assessment of surgical skills in trauma would be useful in many training situations, to include course development, residency training, board certification and preparation for military deployment. We hypothesized that performance metrics for trauma surgery can reliably distinguish expert from novice surgeons.

Study Design: We performed a video task-analysis of 10 attending trauma surgeons and 10 general surgery residents during performance of three vascular exposures (axillary, brachial, femoral arteries) and lower extremity fasciotomy. Performance characteristics of expert and novice surgeons were identified and used to develop a technical skills metric score. The score includes completion of specific surgical steps and assessment of surgical technique. Five evaluators scored blinded videos of the four procedures. Interrater reliability was assessed using intraclass correlation coefficient (ICC). Expert and novice scores were compared using Kruskal-Walis test.

Results: Discriminating characteristics with best evaluator ICC between expert and novice technical skills included obtains necessary exposure ($p<0.00001$), performing procedures without unnecessary dissection ($p<0.00001$), proceeds at appropriate pace ($p<0.00001$), and performs procedure with a logical sequence ($p=0.00001$). ICC displayed in table.

Conclusion: A surgical technical skills metric score can discriminate expert from novice performance required to complete four surgical procedures through the use of discriminating performance characteristics that may be useful for objective surgical skill assessment.

	Intraclass Correlation Coefficient			
Technical Skill	**Axillary artery exposure**	**Brachial artery exposure**	**Femoral artery exposure**	**Fasciotomy**
Obtains necessary exposure	0.98	0.92	0.79	0.97

No unnecessary dissection	0.96	0.91	0.96	0.94
Proceeds at appropriate pace	0.97	0.88	0.94	0.97
Performs with logical sequence	0.93	0.87	0.97	0.95

Appendix 16: Expert Axillary Artery Exposure

Please see digital file of the same name

Supporting Data

Figure 1. Utility function displays values assigned to each combination of pre- and post-training confidence scores. Greater value was assigned to higher post-course confidence levels and to larger improvement, e.g. a change from Likert scale score of 1 pre- (shown on Y axis) to a score of 5 post-training (on the X axis) was assigned a maximum utility score of 100, whereas from 1 to 3 was assigned a score of 50. Negative values were assigned to decreases in confidence levels. Results of utility analysis are displayed in Figure 2.

Pre-training score					
5	-100	-95	-90	-85	0
4	-80	-75	-70	0	85
3	-50	-40	0	70	90
2	-30	0	40	75	95
1	0	30	50	80	100
	1	2	3	4	5
	Post-training score				

Figure 2. Heat map displays the average utility for each procedure taught in the ASSET course. Darker shades correspond to the highest relative improvement and lighter shades to the lowest.

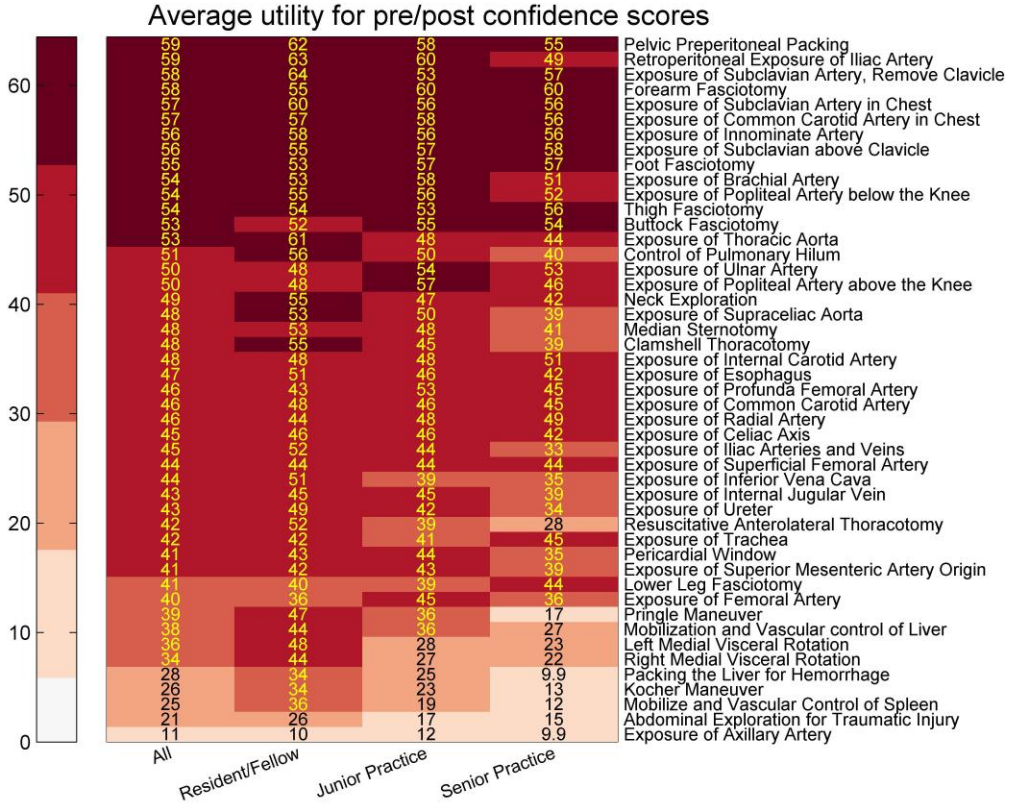

Figure 3: Average reported number of selected surgical procedures performed during surgeons' career displayed by experience level (average number of years of experience: Resident/Fellow: post-graduate year 4.5±0.5, Junior Attending: 3±2 years, Senior Attending: 18±8 years).

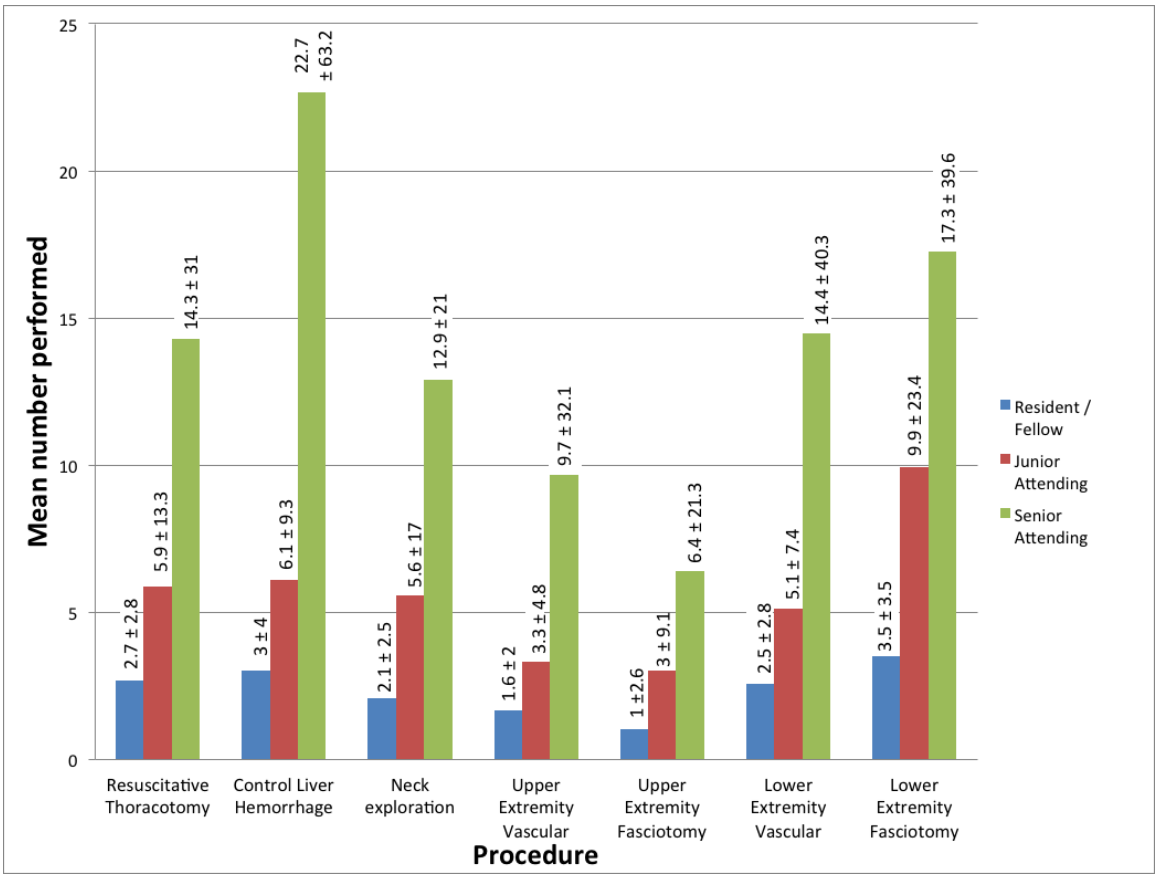

Table 1: Median (Interquartile range) for Pre- and Post-Confidence Scores of Each Anatomic Body Region and Experience Level**. (**p<0.00001 for all pre- and post-score pairs)

	Resident/Fellow		Junior Attending		Senior Attending		All Surgeons	
Body Region	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
Upper Limb	3 (2-4)	4 (4-5)	3 (3-4)	4 (4-5)	3 (2-4)	5 (4-5)	3 (2-4)	4 (4-5)
Lower Limb	3 (2-4)	4 (4-5)	4 (2-5)	5 (4-5)	4 (3-5)	5 (4-5)	4 (2-4)	4 (4-5)
Neck	3 (2-4)	4 (4-5)	4 (3-4)	4 (4-5)	4 (3-4)	5 (4-5)	3 (2-4)	4 (4-5)
Chest	2 (2-3)	4 (4-5)	3 (2-4)	4 (4-5)	3 (2-4)	4 (4-5)	3 (2-4)	4 (4-5)
Abdomen/Pelvis	3 (2-4)	4 (4-5)	4 (3-5)	5 (4-5)	4 (3-5)	5 (4-5)	4 (3-5)	4 (4-5)
All Regions	3 (2-3)	4 (4-4)	3 (2-4)	4 (4-5)	4 (3-4)	5 (4-5)	3 (2-4)	4 (4-5)

Table 2: Change in Self-Reported Confidence Level after ASSET Training on a 1-5 Likert Scale, Displayed as Percent of All Surgeons. Low confidence is defined as Likert 1 to 3, high confidence Likert 4 to 5. P-values are given for Freeman-Halton 1x3 contingency testing.

Confidence Level Change	All Regions	Upper Limb	Lower Limb	Neck	Chest	Abdomen/ Pelvis
All Surgeons						
Low to High	39	49	40	39	45	32
Stayed Low	20	17	22	20	24	18
Stayed High	39	33	37	40	30	48
Freeman-Halton 1x3 p-value	0.025*	<0.0001*	0.060	0.021*	0.017*	0.001*

*p<0.05

Table 3. Change in Self-Reported Confidence Level after ASSET training on a 1-5 Likert Scale, Displayed as Percent of Each Experience Group. Low confidence is defined as Likert 1 to 3, high confidence Likert 4 to 5. P-values are given for Freeman-Halton 3 x 3 contingency testing.

Confidence Level Change	All Regions	Upper Limb	Lower Limb	Neck	Chest	Abdomen/ Pelvis
Resident/Fellow						
Low to High	46	52	42	45	52	43
Stayed Low	23	22	27	24	26	20
Stayed High	30	25	30	30	21	36
Junior Attending						
Low to High	36	51	42	36	42	24
Stayed Low	18	10	15	16	23	20
Stayed High	45	38	42	47	34	55
Senior Attending						
Low to High	31	44	37	33	35	21
Stayed Low	14	11	18	15	19	11
Stayed High	53	44	44	51	45	66
Freeman-Halton 3x3 p-value	0.019*	0.013*	0.125	0.031*	0.007*	<0.0001*

*p<0.05

Table 4: A Mann-Whitney U test between Expert (E) / Novice (N) groups comparing scores from the video evaluation technical skills and discrimination characteristics.

Technical Skill / Discrimination characteristic*	Valid N (E)	Valid N (N)	p-value
Anterior surface	42	37	0.006
Manipulates adventitia	43	34	0.019
Using instruments properly	48	56	0.000
Positions body properly	59	67	0.000
Proceeds at appropriate pace	60	67	0.000
Minimal damage	57	61	0.001
Adequate visual field	60	67	0.000
No unnecessary dissection	58	67	0.000
Progresses toward end goal	58	67	0.000
OpField_Operates through key-hole or too small a skin incision	63	68	0.001
OpField_Operates using full incision	63	67	0.015
OpField_Excessive dissection	60	68	0.000
OpField_Pointless digging and shifting around in surgical field	60	68	0.000
Discrim_OpField_Has a logical operating sequence	62	66	0.000
Discrim_OpField_Lacks anatomical knowledge	41	34	0.002
Discrim_Inst_Improper instruement use	63	67	0.003
Discrim_Inst_Incorrect instrument holding	63	67	0.001
Discrim_Inst_Scalpel use: multiple tentative cuts or cuts tangentially	63	67	0.000
Discrim_Inst_Switches instruments more than you would	61	68	0.001
Discrim_Inst_Uses scissors less than you would	61	67	0.093
Discrim_Inst_Uses sharp dissection confidently	62	67	0.000

*Refer to Attachment #6 for definitions of these criteria and Attachment #9 for the video evaluation sheet

Table 5: Expenditures for the quarter ending 02/28/14

COST ELEMENTS	THIS QUARTER	CUMULATIVE
	12/01/13 – 02/28/14	
Personnel	$43,445	$128,388
Fringe Benefits	$9,267	$27,885
Supplies	-$133,919	$16,941
Equipment	$138,744	$138,744
Travel	$66	$5,215
Other Direct Costs	$1,406	$274,502
Subtotal	$59,009	$591,675
Indirect Costs	-$20,731	$117,762
Fee	$0	$0
Total Expenditures	$38,278	$709,437

*Please note that a correction was made to expenses moved to Supplies last quarter, as they were indeed Equipment. The funding has been moved to the correct cost element now, and as a result, Indirect Costs were adjusted, as they cannot be applied to Equipment.

Table 6: Current Personnel Effort

Name	Role	Effort
Mackenzie, Colin	Principal Investigator	20%
Hu, Peter	Co-Investigator	5%
Hagegeorge, George	Senior Technician	30%
Chen, Hegang	Statistician	2%
Garofalo, Evan	Research Coordinator	100%
Kristy Pugh	Lab tech/Research asst	100%
Holmes, Megan	Research Asst	100%

Appendix 1: Kick-off Meeting Minutes

ASSET Funding Kick-Off Meeting
Thursday, February 14, 2013, 12:30pm – 4:00pm; Executive Board Room HSF II
Minutes

Welcome by Dr Bruce Jarrell Chief Academic and Research Officer (CARO), Senior Vice President, and Dean of the Graduate School UM Baltimore and Introductions by Tom Scalea, Professor of Surgery, Director Shock Trauma Center were followed by a presentation (via Teleconference as all military travel was restricted due to "sequestration") by Mr Tony Story who was substituting for Dr Brett Talbot who was unavailable.

Mr Tony Story: Joint Program Committee One areas include: …Dr Jan Harris Program in Med Simulation and Training..Educational, gaming, information sciences, interoperability.

A) Med Simulation for Combat Casualty Care Training with Patient t Focus

B) Heath services protection

Objective to reduce live tissue training .. …develop new training methods by Oct 1st 2014 No animal use after 2015. SME reduce animals in training ….simulation to replace animals … integrate live animals and simulation.. when not possible to replace animals to augment training. Absence of standardization..and procedures for training …policies to standardize training objectives. Gaps simulator deficiencies .. simulated blood not clotting ….tissue do not feel real , cannot be opened ..secretion characteristics are ifferent … variablility from one system to the next …no secretions..alter students perception ..lack of integration

TARC reviewed R & D portfolio …Tri Service committee tri service initiatives …develop a validation framework ….integrate with assessment tools ..JC P Combat casualty announce 2010..animal v tissue with simulator based systems. Effectiveness of performance of humans …clinical end points … AIBS made 4 awards ..ONR , U Missouri (2) , U Mich. Research Inter variability..airway hemorrhage …answer why and how….using cognitive task analysis tool ..critical cues guide what needs to be included in simulation and to determine what could be included in scenarios.

Simulation class compared animal v simulation… Trauma Hem Airway and EMS …U Mich..gap analysis differences in training…starting ..cholinergic crisis with U Missouri..U Michigan pediatric airway . Gaps identified ..SAS training animal based training,

Combat training system … simulation training and other Fasciotomy and Hem control and amputation. RDDCOM ….mannequin VR Laparotomy simulator….upper body mannekin..craniotomy and crniofacila hemorrhage ..work in progress ..awards for SBIR..advance simulators ..next Gen Haptic interfaces. Intergrated sensor technology …..for Trauma ..new tissues ..immersive training..facila and olfactory recognition …

ASSET Mark Bowyer..Emerg War Surgery Course

Covering incidence of training issues ..video clip of ASSET axillary artery …pictures ..references 1st Cours march 2008 UHUS . 2 faculty to 2 student course ..recommend 4 students to one Faculty …faculty teaches…..very intense . Ist 25 courses Finalized in 2010 i1o courses

Analyse data for 1st 25 courses in 2 year period..more than ½ practicing surgeons .. so Faculty can be Instructors av ys 9.1 y How comfortable..25 specific skills .. befoe and after comfort..follw up after course Universally weel accepted by surgeons. Ideal platform for skills retention. C-STARS .

Dr Sharon Henry .. Committee On Trauma of American College of Surgeons Trauma Skills and Beta site Claire Leidy ..equipment and coordinates..history of cadavers to teach 1997 ..each tem had a day in cadaver labe..not as rigorous of course …now better ..less residents ,,helped this course very structured ,, significant support .. support from Tom Scalea..State Anatomy 1949 .. Mr Body use in ATLS , surgical training and Ron Wade supported ASSET .. gets people to donoate 1400-1500 400 requests for cadavers in course per year ..Ist STC program trained the Instructors…New renovation of Anatomy Board. Train 4 students per cadaver..showed pictures of the cadaver lab…4 students do the work..anatomic cues at each cadaver sites .. refer to as need to do need a projector and fresh cadavers…11 courses 49 instructors 208 students ..importance of course ..should be mandatory course to all residents

COL Stacy Shackelford…Surgical Skills core to our mission at C-STARS ..Forward review in Afghanistan .. medical community exists ..confidence ,,the most dangerous job in the world .. I made it I am here they know how good the medical care is …most meaningfull experience in my carrer emotional involvement when a police officer shot ..every day taking car of out nations heroes….DOD from Gulf war ..first deployment since Vietnam…..questioned ot bring back back and predict casualties ..many had never treated trauma patients ..or had no recent experience .

SS Described other training centers in response to this seemed lack. No test of whether they are capable of doing what they are needed to do when theu get to Afghanistan uS Military 41% 20% Local ANSF 53% IED's 25% GSW and mVC 80% by battle injuries

Surgeons at FSTeam Role 2 .. Role 3 by Navy lRMC Roe 4 GSW to areas not protected by body armor .. fasciotomy ..IED .. lung contusion ..also local trauma stabbed in chest ..MASSIE injury genitor urinaty injures ,,pediatric injuries ..surgical care in austere environment …two beds in OR ..care under constant threat of attack…half of hospital ..vehicle with epxpolsive devices. The bellding stops here..tean survival of casualties graph,,initial data 2005 midlle had consistent data ..av ISS up to up to 12 related ot blst inuries .fatality rates decreased now lest the 3% May 06- Mar 12th ..Hope that we can asses

Ron Wade .. Test HIV .. for ATLS ..disinfection solution … bodies presented to minimize risk 75-100 year prior disease ..less hostile candidates ..EMT and paramedics train on Cadavers …Ronn Wade involved early ..ATLS needed Drs Myers and Gens .. used cadavers for trauma procedures ..skeletal preparation areas converted in to clinical use. Enhance procedures ..within past 4 years upgraded ..second smaller area just opened .. obligation to family and honor their legacy..lab and Board determines responsible ..responsible to disposition to ashes or bury … as per 1975 medical school also serve on the Anatomy Board USUHS basic scientist ..have obligation to meet Army Board ..involved with military and STC for

many years..increased interest in program..to use Anatomy Board resources …funds through DHMH ..self supporting entity .nominal fees to enhance services .

When simulation came in ..35 years cadaver …need pristine cadaver ..simualtion center offers more of that ,, not fresh specimens because of public health… efforts of donors and citizen of MD …70,000 donors on the books . Sensitive use of cadavers ..Army Policy .. get informed consent from donor and the family after donation ..organ tissue programs . Army cadaver donation is specific to military use .. .. IOAM organization since ..informed consent

Variation in cadaver cost 8K to 250 dollars across the US ..differences as State Board .Funeral costs are covered. Depends where you die . Costs of regulations …ofter coporate needs v education ,, gov v commercial ,,market value .. no legal value .. but realistically a commodity … . The MD State Anatomy Board need to meet needs 3 medical schools …commercial Stryker .. all institutional based .. transport ….1973 ..more uses ..but clinical physician allied health, resp therapy , anatomic specimens ..plastination and teaching specimens .. no surplus. .

Stipend not subject to institutional tax .. check will be processed on provision of SSN (and for direct participants with signed consent.

Karen coordination IRB status and getting system of research support in place .

Appendix 2: RCI Invoice for AV Hardware

Work Order

10721 Hanna Street
Beltsville MD 20705

Date
1/31/2011

Name / Address
UMB Accounts Payable Department Saratoga Street Offices 220 Arch Street Rm. 02-123 Baltimore, MD 21201

P.O. No.	Terms	Rep	Project
PUR01-0000016885	Net 30	DJD	PO# PUR01-0000016885 UMB B-108

Description	Qty	Cost	Total
The following invoice is for the B-018 Anatomy Lab A/V system installation. Please reference PO# PUR01-0000016885 The following equipment has been installed and tested complete as of: March 18, 2011			
Ashly ne24.24m 8x8 - Protea II Audio Mixer (8x8)	1	1,667.00	1,667.00T
Bose 161 - Speakers	4	90.00	360.00T
Crestron Pro-2 - Controller	1	2,034.00	2,034.00T
Crestron C2COM-3 - RS-232 Expansion cards	2	396.00	792.00T
Crestron - ethernet expander	1	509.00	509.00T
Crestron E-Control 2 - Software	1	283.00	283.00T
Crestron TPS-4L - Touch Panel	1	707.00	707.00T
Middle Atlantic rack mount for TPS-4L	1	98.00	98.00T
Crestron TPMC-8X - Touch Panel, 8"	1	2,147.00	2,147.00T
Crestron TPMC-8X-DSW - Wall Docking Station	1	1,130.00	1,130.00T
Crestron WMKT-8X-DSW - Wall Mounting Kit	1	85.00	85.00T
Crestron QM-AMP3X80MM - Amplifier	1	565.00	565.00T
Crestron CNPWS-75 - Power Supply (included)	1	0.00	0.00T
Linksys EZXS88W - switch	1	36.00	36.00T
Extron 60-692-01 -- DA6VEQ composite video da	1	294.00	294.00T
Exgtron 60-190-10 RSU19 - Rack Kit	1	74.00	74.00T
Extron 60-759-22 - Extender D	7	221.00	1,547.00T

Subtotal	
Sales Tax (0.0%)	
Total	

Phone #	Fax #
301-931-9001	301-931-9002

FINANCIAL SERVICES
ACCOUNTS PAYABLE
2011 MAR 29 PM 12 31

Work Order

10721 Hanna Street
Beltsville MD 20705

Date
1/31/2011

Name / Address
UMB Accounts Payable Department Saratoga Street Offices 220 Arch Street Rm. 02-123 Baltimore, MD 21201

P.O. No.	Terms	Rep	Project
PUR01-0000016885	Net 30	DJD	PO# PUR01-0000016885 UMB B-108

Description	Qty	Cost	Total
Extron 60-726-01 - Scaler	3	943.00	2,829.00T
Extron 60-476-01 - VSC 500 - Comp to video scan converter	1	1,125.00	1,125.00T
Extron 60-190-01 RSU129 Rack Kit	2	74.00	148.00T
Extron 60-334-21 -- Crosspoint Ultra 88HVA	1	4,808.00	4,808.00T
JVC SR-HD1250 - DVD Recorder	1	1,096.00	1,096.00T
Middle Atlantic ERK-4425 -- Equipment rack	1	531.00	531.00T
Middle Atlantic CBS-ERK-25 Caster Base	1	122.00	122.00T
Middle Atlantic PDT-2020C-NS -- Vertical power strip	1	96.00	96.00T
Middle Atlantic ERK-4QFT-FC - Fan Top	1	336.00	336.00T
Middle Atlantic RSH rack mount for JVC DVD Recorder	1	98.00	98.00T
APC SC1500 - UPS Backup	1	339.00	339.00T
Furman PL Pro DMC - Power Distro	1	283.00	283.00T
Marshall V-R81PA - Video monitor	1	1,769.00	1,769.00T
Shure MX202WP/C - Microphone	2	161.00	322.00T
Shure ULXP14/51-G3 Wireless mic system	1	915.00	915.00T
Sony EVI-D70 camera	1	876.00	876.00T
Vaddio 999-2000-205 - Wall mount for Sony EVI-D70	1	46.00	46.00T
RSS110125-1 RCI Custom Panel	1	101.00	101.00T
Wire and installation hardware	1	1,805.00	1,805.00T
Extron 60-1022-01 - PA124 Power Supply	1	0.00	0.00T
Engineering/Programming/Installation Labor	1	12,401.00	12,401.00
Maintenance Agreement	1	4,080.00	4,080.00

Subtotal	$46,454.00
Sales Tax (0.0%)	$0.00
Total	$46,454.00

Phone #	Fax #
301-931-9001	301-931-9002

Appendix 3: UMB invoice for TRR system

Tax Invoice

AlfredHealth

ABN: 27 318 956 319

Alfred Health incorporates The Alfred, Caulfield Hospital and Sandringham Hospital.
Finance Department, The Alfred, PO Box 315, Prahran VIC 3181
Telephone : 03 9076 5442 Fax: 03 9076 2102

Page
1 of 1
Invoice Number
INV00138482
Invoice Date
3-Jul-2013
Reference

UMB Accounts Payable Department
Saratoga Street Offices
220 Arch Street
Rm. 02-123
Baltimore MD 21201
UNITED STATES OF AMERICA

email: accounts.receivable@alfred.org.au

Description	Qty	Rate	Pre GST Amt	GST Amt	Full Amount
sundry income	1	AU$ 273,405.230	273,405.230	0.00	AU$ 273,405.23

Purchase Order: PUR01-0000024662
Site & Subject Specific License TRR Software including TRR Algorithm
Designer Tool scripted for ASSET
Redesigned User Interface for TRR/ASSETT
TRR Algorithm Design Training Support
TRR Algorithm Testing
Simulation training and verification
Documentation, Version Control & User Manuals
Systems monitoring and technical support for 3 years
Payable in Australian Dollars $ 273,405.23
(USD$250,000=AUD$273,405.23 at July4th 2013,
USD$1=AUD$1.09362)

Total	**0.00**	**AU$ 273,405.23**
Payment Received		0.00
Total Payable		AU$ 273,405.23

To ensure the correct identification, please detach the slip below and return it with your payment.

Payment Terms: 14 Days

Payment From	Invoice Number	Invoice Date	Total Payable
UMB Accounts Payable Department UMB002	INV00138482	3-Jul-2013	AU$ 273,405.23

Credit Card Number	Expiry Date	Signature	$

Type	Bank Card Master Card VISA Diners Amex	Name on card:	

EFT Payment Details

Please ensure that invoice number is quoted and remittance advice is faxed or emailed to the above address

Westpac BSB: 033-079 Account No: 114772

Assessing Surgical Training: a Utility Analysis of the Advanced Surgical Skills for Exposure in Trauma Course

Stacy Shackelford, MD, FACS[1], Evan Garofalo, PhD[2], Megan Holmes, BS[3], Konstantinos Kalpakis, PhD[4], Sharon Henry, MD, FACS[5], Colin Mackenzie MBChB[6], Mark Bowyer, MD, FACS[7]

Brief title: Assessing Surgical Training
Meeting presentation info: Not presented
Disclosures: This research was funded through US Army MRMC Award W81XWH-13-2-0028
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Abstract

Background: Surgical experience with managing traumatic hemorrhage has declined in training programs and in practice. To address this, the American College of Surgeons launched the Advanced Surgical Skills for Exposure in Trauma (ASSET) course in 2010,

a human cadaver-based course to review the anatomy, skills and techniques for rapid vascular exposures.

Study design: We compared self-reported confidence of participants (n=523) with surgical tasks (n=47) at baseline and directly after ASSET training to examine the effect of training. Median pre- and post-training self-reported confidence scores were assessed by Wilcoxon matched pairs test, directional change by Freeman-Halton contingency tests, and relative improvement for specific procedures using utility values assigned for each possible combination of pre- and post-training confidence levels.

Results: All surgeons recorded improved confidence in all five anatomic body regions after ASSET training ($p<0.0001$). Following the course, surgeons reported a high confidence level in 78% of the 47 procedures. The body region most improved by ASSET training was the upper limb, with 49% of surgeons improving from low to high confidence (Freeman-Halton 1x3 $p=0.017$). Residents/fellows achieved the greatest improvement in confidence levels. The highest utility value occurred with pelvic preperitoneal packing and retroperitoneal exposure of the iliac artery. The lowest utility occurred with exposure of the axillary artery.

Conclusions: This study highlights the broad positive impact of the ASSET course on trauma surgical skills. Confidence was most improved for residents/fellows. An objective performance measure of surgical skills would be valuable for future course development.

INTRODUCTION

Dramatic advances have occurred in the field of surgical training over the past decade in the areas of virtual reality simulation,[1-4] cadaver-based instruction,[5-8] and live animal models.[9-12] These training methods have helped to fill widening training gaps in surgical residency programs, as well as to create unique ways for practicing surgeons to maintain their skills.[13-17]

The Advanced Surgical Skills for Exposure in Trauma (ASSET) course, launched in 2010, is an American College of Surgeons approved human cadaver-based 1-day skills course that systematically reviews all of the major vascular exposures in the body. Emphasizing that vascular exposure is the requisite first step in achieving control of major hemorrhage, the course was designed to support not only trauma surgery but to improve the confidence of all surgical specialists who operate near major blood vessels. The course has been adopted in many residency programs as well as several military pre-deployment courses as a focused review of trauma surgical skills for surgeons who may or may not practice trauma on an ongoing basis.

The benefit of the ASSET course has been previously demonstrated through review of the initial participants' self-assessed skills for the vascular exposures taught during the course.[5,7] Now that experience with the ASSET course has increased, this paper will examine the benefits of the course utilizing a greatly expanded sample size and different outcomes incorporating pre-training experience and relative improvement with training. We aim to examine the effect of the ASSET course on surgical skills for surgeons of differing experience levels and for specific anatomic regions of the body.

METHODS

Data included in this study were collected from enrollment materials and a questionnaire given to ASSET course participants in 53 ASSET courses between 2010 and 2013.[7] Enrollment forms sent by the American College of Surgeons (ACS) gathered basic demographic and professional information including specialty, level of training and experience with specific surgical procedures. A questionnaire was given in conjunction with the course to collect information about each participant's baseline self-reported confidence level with specific surgical tasks before ASSET training and with the same tasks directly after the training. Course participants rated their confidence with the procedures on a 5-point Likert scale[18] (1=no confidence; 5=a lot of confidence) for 47 procedures and surgical tasks.[5] For the purposes of analysis, Likert scale values of 1-3 were defined as low confidence and values of 4-5 were defined as high confidence.

To assess the self-reported benefits of ASSET training for surgeons of different levels of experience, participants were organized into three groups based on professional experience level. These groups were defined as residents and fellows, junior attending (<8 years post-residency), and senior attending (8+ years post-residency). The 47 surgical procedures taught in the course were classified into five body regions: upper extremity, lower extremity, neck, chest, and abdomen/pelvis. For each participant, confidence level change from before (pre) to after (post) ASSET training was determined utilizing various methods. Body region scores were determined for each participant using the median score of all procedures in each region before and after training and compared using Wilcoxon matched pairs test. The direction of change of confidence scores was determined (increase, decrease, stayed the same) for each category of surgeons using

Freeman-Halton 3x1 (all surgeons) and 3x3 (by experience level and body region) contingency tests.

We also sought to describe an assessment of relative change before and after training for each procedure. A utility value for each possible combination of pre- and post-training confidence levels was assigned with the greatest positive value given to any improvement resulting in a self-confidence level of 5 after the course and the lowest positive value to a self-confidence score of 1 after the course, with null indicating no change. Corresponding negative values were assigned for a lowering in self-confidence scores. The methods of assignment of specific utility values assigned are illustrated in Figure 1. We computed the average utility value for the participants' pre-training and post-training scores, grouped by procedure and participant's experience level. We then collected these averages into a matrix, where rows correspond to procedures and columns to experience levels. This matrix, constructed using MATLAB 2012b, is displayed using the heatmap technique[19] in Figure 2.

RESULTS

Five hundred twenty-three surgeons completed the ASSET course surveys before and after the course. Two hundred four attending surgeons recorded their specialty and all (n=523) recorded their experience level. Of those who recorded their surgical specialty, 41% were general surgeons, 29% trauma/acute care surgeons, 12% orthopedic surgeons, and 17% other surgical specialists. By experience level for all surgeons, there were 244 residents and fellows and 279 attending surgeons, of whom 171 were junior and 108 senior attendings. The mean (± standard deviation [SD]) experience level of residents/fellows was post-graduate year 4.5±0.5, junior attendings 3±2 years in practice,

and senior attendings 18±8 years in practice. The mean (± SD) number of selected procedures performed by each experience level are illustrated in Figure 3.

Confidence level changes pre- and post-ASSET training

For all experience levels, surgeons recorded significantly higher confidence to perform procedures in all five anatomic body regions after ASSET training (Wilcoxon matched pair $p<0.00001$). Median pre- and post-training confidence levels are displayed in Table 1.

Prior to attending the ASSET course, survey of all surgeons demonstrated that 39% of surgeons reported a high confidence level for all regions combined, with the lowest pre-course confidence in chest (30% high confidence) and highest pre-course confidence in abdominal/pelvic procedures (48% high confidence); all of these surgeons also reported high confidence after the course and are illustrated in Table 2 in the category "stayed high". Following the course, 78% of all surgeons reported a high confidence level for all regions, including surgeons who improved from low to high (39%) and surgeons who stayed high (39%). Of all surgeons who initially reported a low overall confidence level, 20% retained a low overall confidence after the course (Freeman-Halton 1x3 $p=0.025$) (Table 2).

The ASSET training improvements stratified by body region based on the percentage of surgeons changing from low to high confidence after the course occurred in the following order (greatest to least improvement): upper limb, chest, lower limb, neck, and abdomen/pelvis (Table 2). In upper limb procedures, 49% of surgeons improved from low to high confidence while another 33% started and stayed high (Freeman-Halton 1x3 $p=0.017$). By comparison, surgeons reported the least overall improvement in

abdomen/pelvis procedures, largely due to a high starting confidence level of 48% which stayed high and 32% of all surgeons moved from low to high confidence in abdomen/pelvis procedures (Freeman-Halton 1x3 p=0.001) (Table 2).

Confidence scores stratified by surgeon experience demonstrated that more residents and fellows recorded a pre-course low confidence level for all body regions of 69% compared to 54% of junior attendings and 45% of senior attendings; post course outcomes for those with a low starting confidence are illustrated in Table 3 as a change from "low to high" or "stayed low". The percentage of surgeons who recorded high pre and post confidence ("stayed high") increased significantly with experience level for each body region, with corresponding lower rates of converting from low to high confidence. (Table 3)

Assessment of utility

The utility values for all starting confidence levels 1 through 4 are illustrated in Figure 2, with darker shades corresponding to the highest utility and lighter shades to the lowest. The matrix displays the average utility value of pre-/post-training scores; the legend provides the mapping of matrix values to colors, while average utility values are also shown in each individual cell. The lowest average utility was obtained for exposure of the axillary artery, indicating the least improvement in confidence level with training. Various intra-abdominal exposures, femoral artery exposure, and lower extremity fasciotomy also received relatively low utility values. The highest utility was achieved with pelvic preperitoneal packing and retroperitoneal exposure of the iliac artery. This analysis provides a useful course development tool, illustrating how training has affected

confidence levels for each specific procedure taught in the course. All utility values were significant ($p<0.05$) except packing the liver for hemorrhage for senior attending.

DISCUSSION

The epidemiology of traumatic injury has gradually shifted over the past five decades, with a number of factors such as improved prevention,[17,20-22] violence outreach programs,[23-27] non-operative treatment of solid organ injuries[13,28-29] and penetrating abdominal wounds,[30-32] and rapid advances in interventional radiology[33-34] combining to reduce the total number of operations performed by individual surgeons. Additionally, the implementation of work hour restrictions for residents in 2003 reduced the total in-hospital work hours to 80 hours/week.[35] Total operative trauma cases for graduating general surgery chief residents have decreased from an average of 60.4 cases per resident in 1999 to 33.5 cases in 2012. In particular, major vascular procedures decreased from an average of 8 cases per resident in 1999 to 0.7 cases in 2012.[36]

Advances in surgical training have simultaneously progressed, potentially offering a mechanism to develop and maintain skills outside of actual patient care. Advanced laparoscopists embraced simulation training early. Numerous analyses have been conducted to assess the efficacy of laparoscopic simulation trainers, especially as the technology has rapidly advanced from low-fidelity physical models to high-fidelity virtual models. The majority demonstrate a significant increase in both learner confidence and proficiency.[4,37-39] A number of cadaver and live animal simulation models have further advanced surgical skills training.

The ASSET course, launched in 2010, was developed by the American College of Surgeons to systematically teach exposure of all major blood vessels in the body along

with fasciotomy of upper and lower extremity using a human cadaver model. These skills are important for management of major hemorrhage in traumatic injury. Beginning with the first ASSET course, a detailed questionnaire of surgical experience and pre- and post-training confidence level with each of the 47 procedures taught in the ASSET course was collected. Confidence level was assessed using a Likert scale[18]. Our analysis demonstrated that surgeons of all specialties enrolled and all experience levels derived benefit from the course by improving overall confidence levels with vascular exposures. Confidence was most improved for procedures in the upper limb. Additionally, residents/fellows achieved the greatest improvement in confidence levels.

This method of surgical skills assessment has many limitations. The individual surgeon's experience with procedures was recorded as an estimate from memory and does not represent an exact count of actual procedures performed. Additionally, the self-reported confidence level for each procedure is a subjective measurement that may vary significantly from one subject to the next, or at different stages of experience in the same individual. Also, due to the large number of procedures queried, an element of survey fatigue may have reduced the accuracy of results, particularly when comparing pre- and post-scores for specific procedures. We sought to group the 47 specific procedures into body regions for the purpose of analysis to reduce the potential variability. However, ultimately this still remains a subjective assessment of surgical skills, and a more objective measurement of surgical performance by trained evaluators, including competence evaluation as described for orthopedic surgeons[40] is needed, rather than self-assessment.

Medical training in general, and simulation based training in particular, have suffered from a lack of objective outcome measures, with confidence levels commonly used as the outcome measure.[41-43] In most cases, assessing emergency skills on actual patients would not be possible due to the infrequency of specific life-threatening conditions and the challenges of observing and recording emergency treatments. An objective test of surgical skills would be useful in a number of situations. Such a test would be beneficial to assess the effectiveness of a specific surgical skills course or perhaps to show improvements in technical skills throughout an entire residency program. An objective skills test could be a useful way to compare different teaching methods. The military has an expressed need to ensure that deploying surgeons are prepared for their upcoming mission. And finally, it is conceivable that an objective surgical skills test could be incorporated into board certification or recertification in the future. An objective means of assessing surgical skills does not currently exist.

CONCLUSION

The ASSET course is an effective training method that increases surgeons' confidence levels in performing trauma-specific exposures. Although there were significant differences in the degree of improvement between different experience levels, confidence levels improved for all categories of surgeons in all body regions. Confidence was most improved for procedures in the upper limb. Residents/fellows achieved the greatest improvement in confidence levels. An objective performance measure of surgical skills would be valuable to refine future course development.

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Figure 1. Utility function displays values assigned to each combination of pre- and post-training confidence scores. Greater value was assigned to higher post-course confidence levels and to larger improvement, e.g. a change from Likert scale score of 1 pre- (shown on Y axis) to a score of 5 post-training (on the X axis) was assigned a maximum utility score of 100, whereas from 1 to 3 was assigned a score of 50. Negative values were assigned to decreases in confidence levels. Results of utility analysis are displayed in Figure 2.

Pre-training score	1	2	3	4	5
5	-100	-95	-90	-85	0
4	-80	-75	-70	0	85
3	-50	-40	0	70	90
2	-30	0	40	75	95
1	0	30	50	80	100

Post-training score

Figure 2. Heat map displays the average utility for each procedure taught in the ASSET course. Darker shades correspond to the highest relative improvement and lighter shades to the lowest.

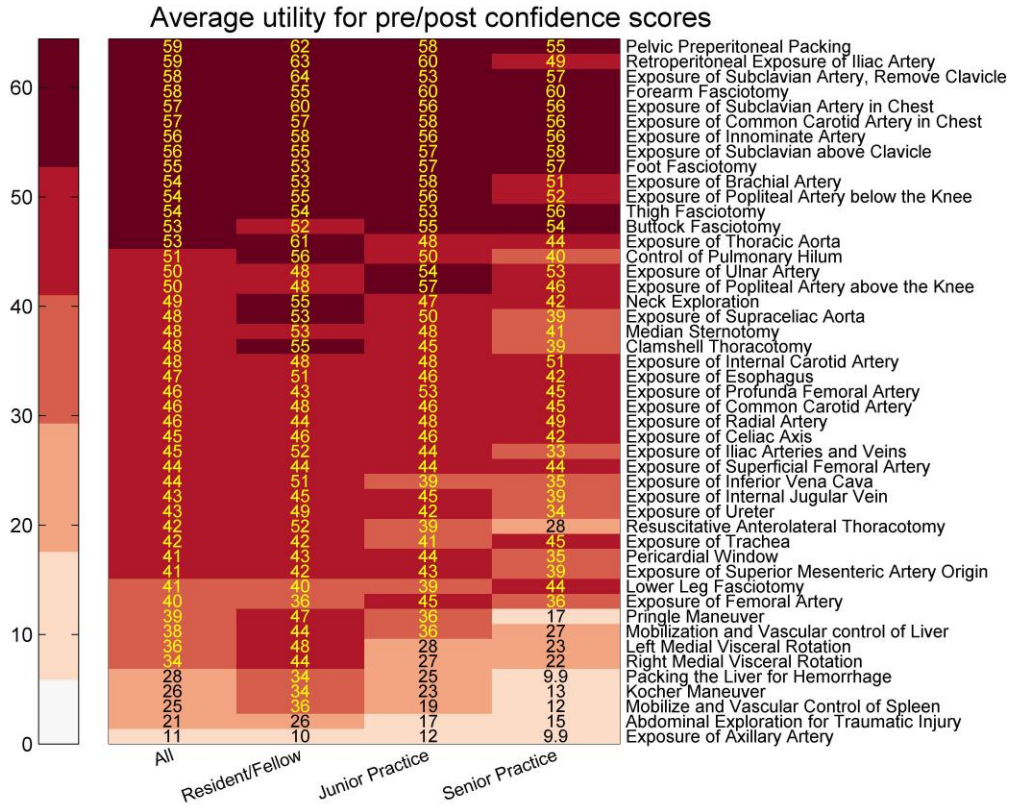


Figure 3: Average reported number of selected surgical procedures performed during surgeons' career displayed by experience level (average number of years of experience: Resident/Fellow: post-graduate year 4.5±0.5, Junior Attending: 3±2 years, Senior Attending: 18±8 years).

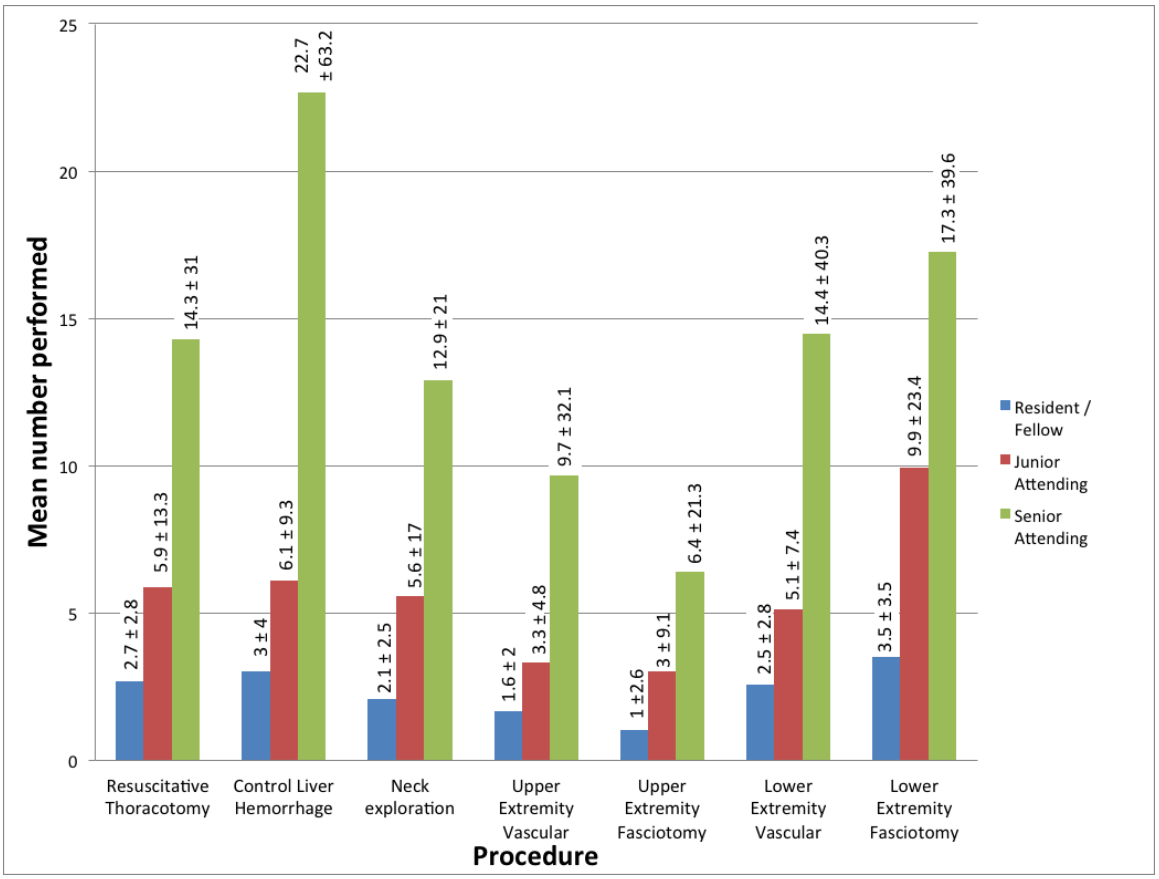


Table 1: Median (Interquartile range) for Pre- and Post-Confidence Scores of Each Anatomic Body Region and Experience Level**. (**$p<0.00001$ for all pre- and post-score pairs)

	Resident/Fellow		Junior Attending		Senior Attending		All Surgeons	
Body Region	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
Upper Limb	3 (2-4)	4 (4-5)	3 (3-4)	4 (4-5)	3 (2-4)	5 (4-5)	3 (2-4)	4 (4-5)
Lower Limb	3 (2-4)	4 (4-5)	4 (2-5)	5 (4-5)	4 (3-5)	5 (4-5)	4 (2-4)	4 (4-5)
Neck	3 (2-4)	4 (4-5)	4 (3-4)	4 (4-5)	4 (3-4)	5 (4-5)	3 (2-4)	4 (4-5)
Chest	2 (2-3)	4 (4-5)	3 (2-4)	4 (4-5)	3 (2-4)	4 (4-5)	3 (2-4)	4 (4-5)
Abdomen/Pelvis	3 (2-4)	4 (4-5)	4 (3-5)	5 (4-5)	4 (3-5)	5 (4-5)	4 (3-5)	4 (4-5)
All Regions	3 (2-3)	4 (4-4)	3 (2-4)	4 (4-5)	4 (3-4)	5 (4-5)	3 (2-4)	4 (4-5)

Table 2: Change in Self-Reported Confidence Level after ASSET Training on a 1-5 Likert Scale, Displayed as Percent of All Surgeons. Low confidence is defined as Likert 1 to 3, high confidence Likert 4 to 5. P-values are given for Freeman-Halton 1x3 contingency testing.

Confidence Level Change	**All Regions**	**Upper Limb**	**Lower Limb**	**Neck**	**Chest**	**Abdomen/ Pelvis**
All Surgeons						
Low to High	39	49	40	39	45	32
Stayed Low	20	17	22	20	24	18
Stayed High	39	33	37	40	30	48
Freeman-Halton 1x3 p-value	0.025*	<0.0001*	0.060	0.021*	0.017*	0.001*

*p<0.05

Table 3. Change in Self-Reported Confidence Level after ASSET training on a 1-5 Likert Scale, Displayed as Percent of Each Experience Group. Low confidence is defined as Likert 1 to 3, high confidence Likert 4 to 5. P-values are given for Freeman-Halton 3 x 3 contingency testing.

Confidence Level Change	**All Regions**	**Upper Limb**	**Lower Limb**	**Neck**	**Chest**	**Abdomen/ Pelvis**
Resident/Fellow						
Low to High	46	52	42	45	52	43
Stayed Low	23	22	27	24	26	20
Stayed High	30	25	30	30	21	36
Junior Attending						
Low to High	36	51	42	36	42	24
Stayed Low	18	10	15	16	23	20
Stayed High	45	38	42	47	34	55
Senior Attending						
Low to High	31	44	37	33	35	21
Stayed Low	14	11	18	15	19	11
Stayed High	53	44	44	51	45	66
Freeman-Halton 3x3 p-value	0.019*	0.013*	0.125	0.031*	0.007*	<0.0001*

*p<0.05

Appendix 5: OEI invoice for Physical models

Operative Experience, Inc.

500 Principio Parkway West
Suite 900
North East, MD 21901

Invoice

Date	Invoice #
6/11/2013	21

Bill To	Ship To
University of Maryland Accounts Payable Dept. Saratoga Street Offices 220 Arch St. Rm. 02-123 Baltimore MD 21201	655 W. Baltimore St BRB Rm. B-025 Baltimore, Maryland 21201 Attention: Sara J. Canan

S.O. No.	P.O. No.	Terms	Project
8	0000023793	Due on Receipt	

Item	Description	Ordered	Prev. Invoi...	Invoiced	Rate	Amount
Surgical Fasc. ...	Hyper Realistic Physical model of Human Anatomy- Lower Extremity Leg as well as Upper.. Delivered on	100	0	30	800.00	24,000.00
Surgical Arm	Hyper Realistic Physical Models of Human Anatomy- Upper Extremity Arm Due,	100	0	30	800.00	24,000.00
Shipping and ...	Delivery Schedule - April 22, 2013 2 of the 2 part Fasciotomy Leg -May 16, 2013 3 of the 2 part Fasciotomy Leg -May 24, 2013 2 of the 2 part Fasciotomy Leg -May 24, 2013 2 Surgical Arms -June 3, 2013 23 of the 2 part Fasciotomy Leg & 28 Surgical Arms.	5	0	1	200.00	200.00

2013 JUN 24 AM 7 20

FINANCIAL SERVICES
ACCOUNTS PAYABLE

Total	$48,200.00
Payments/Credits	$0.00
Balance Due	$48,200.00

RASP Evaluator Training Handbook
December 2013

Introduction

This handbook will serve as a guide and reference for evaluating a subset of surgical procedures taught in the Advanced Surgical Skills for Exposure in Trauma Course (ASSET) as part of the corresponding Retention and Assessment of Surgical Performance Project (RASP). You will view four ASSET procedures either in person or on video in order to score the individual participants performance on the score sheet provided. The purpose of this evaluation is for you to use your professional expertise to gauge the surgical technical skill level of each participant in gaining vascular control of the axillary, brachial, and femoral arteries and decompression of the 4 compartments around the tibia and fibula.

The first section of this handbook will contain the ASSET Faculty Manual Direction for each RASP procedure which you will use as your guide to determine the appropriate surgical approach. Four surgeries will be evaluated including: 1) axillary artery exposure; 2) brachial artery exposure; 3) femoral artery exposure; and, 4) lower extremity fasciotomy. The second section of this handbook includes the Evaluation sheets for the respective procedures, as well as, instructions describing how to fill them out. The Dictionary of Definitions spells out the terms used in the evaluations of surgical technical skills.

RASP Evaluation Process.

1) The RASP study candidate will be read a standard script (the same for all candidates whether they are in Phase 2 or 3 of the RASP study) before the start of each of the 4 RASP Procedures.
2) The script will describe a case scenario and provide instructions about what surgical approach is required (e.g. expose and gain proximal vascular control of the Femoral Artery, including the CFA, SFA and Profunda).
3) The RASP study candidate will be given the chance to ask questions, and then asked to proceed.

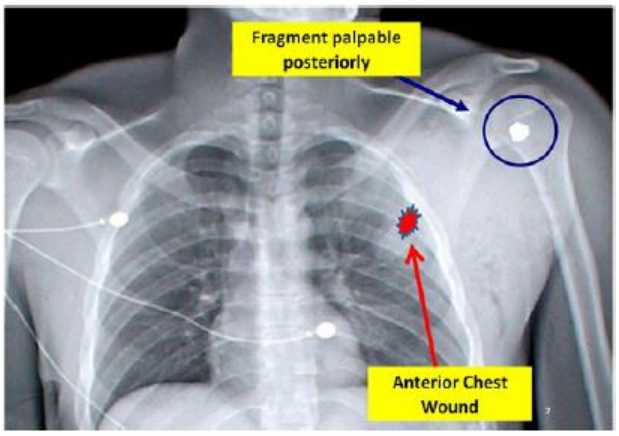
RASP Evaluator Role

1) The Evaluator should not ask the candidate questions
2) The evaluator should observe closely and record these surgical technique observations on the evaluation sheet , either electronically, or with pencil and paper
3) No prompting is allowed. No suggestions or teaching are allowed. Details of the case history may be repeated and the information may be displayed on the screen alongside the RASP study candidate.
4) The order of RASP procedures may vary. You and the RASP study candidates will be advised the Order in which the 4 RASP procedures will occur.

Section I: RASP Procedures (Taken from the ASSET instructor Handbook)

RASP Case One: Vascular Exposure of the Axillary Vessels

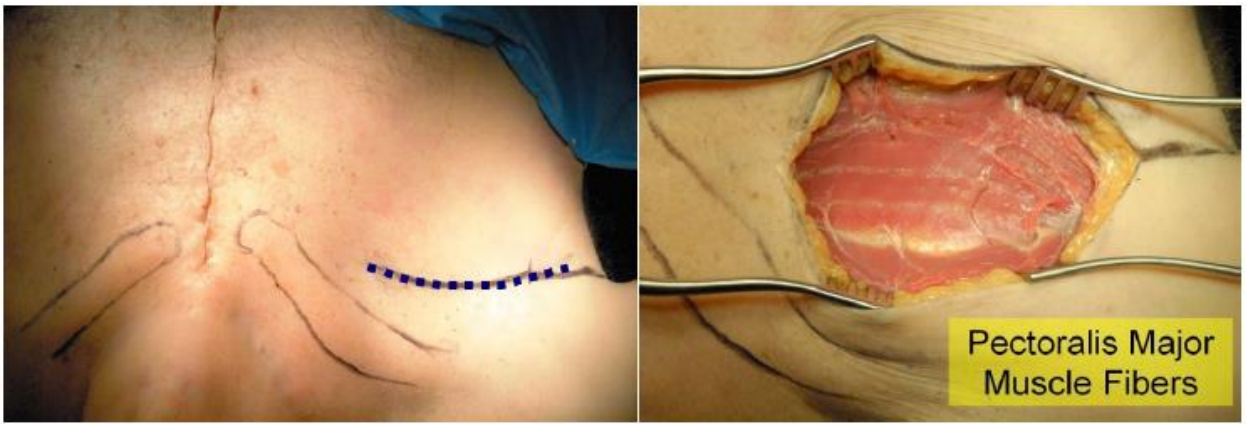
- 24 y/o male who was riding his bicycle to Sunday school "on a Friday night" attacked by two dudes and sustained GSW to the left upper chest
- Reported to have large amount of bright red pulsatile blood at scene
- On arrival awake and talking
- BS =Bilaterally B/P 96/60, HR = 126
- c/o pain at site of wound
- Unable to move left arm with decreased sensation
- Entrance wound only with large hematoma
- Brachial, radial and ulnar pulses absent hand cool and pale



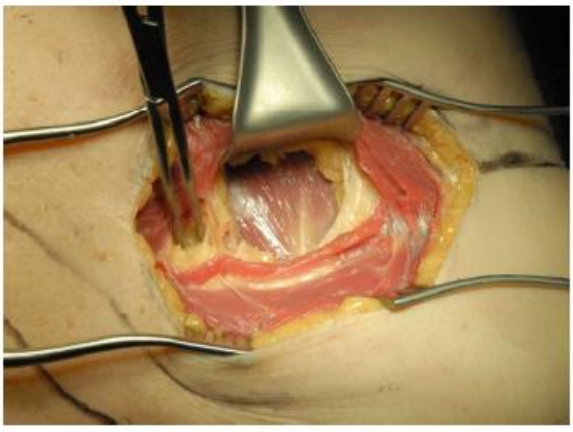
Teaching Objectives/Steps:

1. Anatomy
a. Subclavian becomes axillary as it crosses the first rib
b. The artery is divided into 3 sections by the pectoralis minor muscle
c. The brachial plexus is intimately associated with the artery and care must be taken to avoid injury during rapid exposure

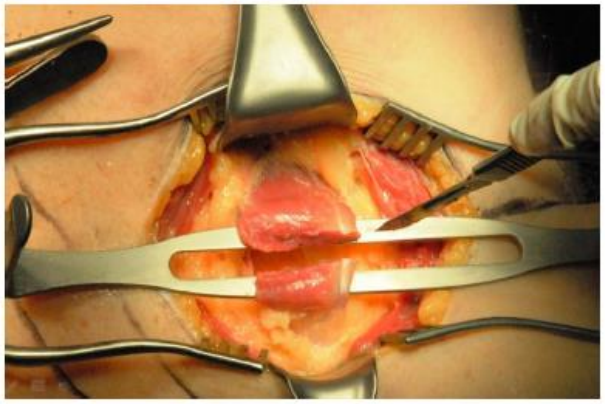
2. Identify landmarks for exposing the axillary artery (head at bottom of images)
a. Inferior edge of mid- clavicle
b. Deltopectoral groove

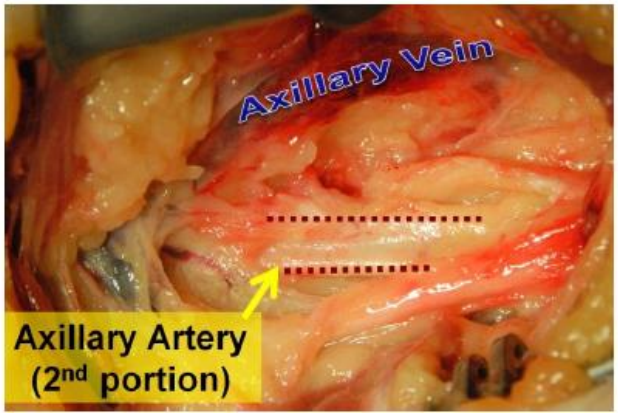


3. Have students cutdown on Axillary artery
a. Incision in deltopectoral groove inferior border of middle of clavicle to anterior axillary fold
b. Split the pectoralis major muscle in the direction of fibers, in dire emergencies the pectoralis major is taken down from its humeral insertion
c. With the pectoralis major retracted; the pectoralis minor is revealed



d. The pectoralis minor is divided to expose the second portion of the axillary artery (see image below)





4. Identify/discuss following structures:

a. Relationship of Brachial plexus, Artery and Vein

5. Debrief of Pearls and Pitfalls of Axillary Artery vascular control

a. A single axillary vein typically runs with the artery.

b. The brachial plexus is intimately associated with the axillary artery, and care must be taken to avoid nerve injury during quick exposure.

c. Slow, incomplete, or piecemeal division of pectoral muscles delays hemorrhage control.

d. Avoid this by inserting a finger or clamp under the entire muscle/tendon and dividing it quickly

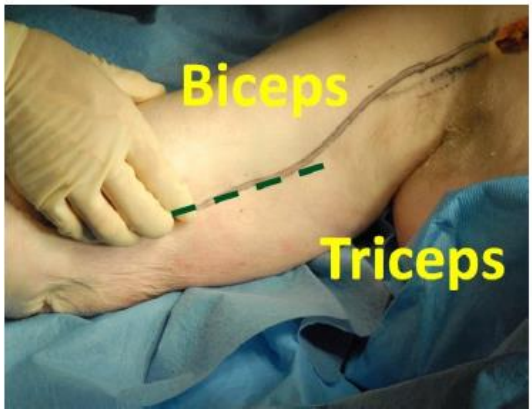
e. An inadequate incision makes exposure and hemostasis difficult; a generous incision is warranted to ensure rapid vascular control.

RASP Case Two: Vascular Exposure of the Brachial Vessels

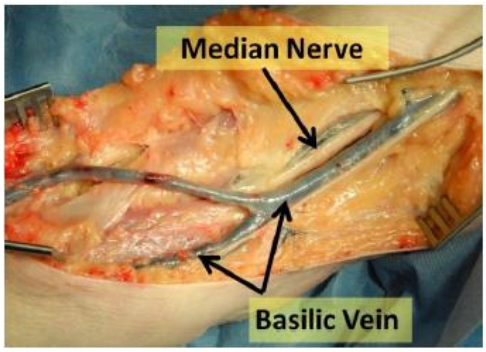
- 32 y/o male accidentally shot at close range with a hunting rifle in the left arm
- Reported to have large amount of bright red pulsatile blood at scene
- Active pulsatile bleeding from medial wound (Controlled with tourniquet)
- Absent distal pulses
- B/P = 100/68, HR = 120
- No other injuries

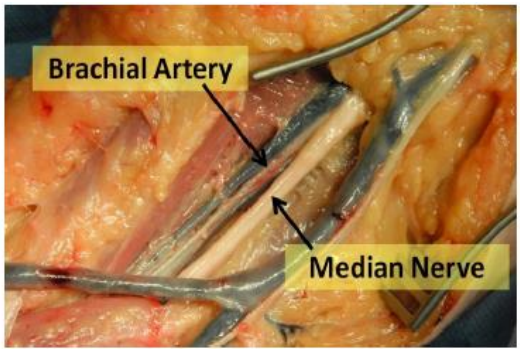
Teaching Objectives/Steps:

1. Identify the Landmarks
a. Triceps & Biceps Muscles
b. Bicepital groove



2. Expose the proximal brachial artery



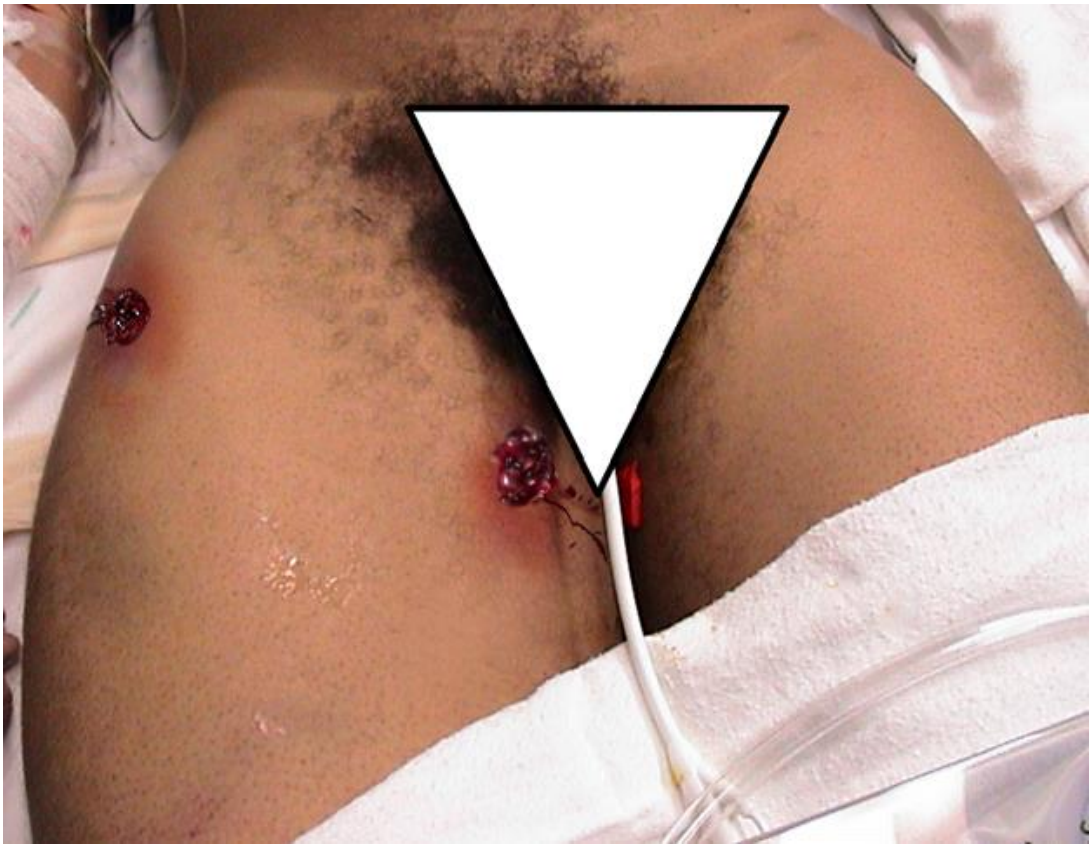


a. The median nerve lies directly over the brachial artery in the mid-arm and is superior to the basilic vein seen with the medial antebrachial cutaneous nerve inferior.
b. Further dissection exposes the brachial artery and its paired veins deep and superior to the median nerve.

4. Debrief of Pearls and Pitfalls Brachial Artery vascular control
a. In the mid-upper arm, the median nerve may be injured by careless dissection, as it runs directly on the artery.
b. Knowledge of the anatomic relationships of the median nerve to the artery and its closely adherent paired veins is important to prevent iatrogenic injury
c. An injured brachial or basilica vein can be resected and used as an arterial conduit.
d. Care should be taken not to harm the vein during dissection and harvest.
e. The brachial artery of a young, healthy patient is very vasoreactive and can be surprisingly small when in spasm.
f. If there is question as to whether the true brachial artery has been found, it should be followed proximally until doubt is removed.

RASP Case Three: Vascular Exposure of the Common Femoral, Superficial Femoral and Profunda Arteries

- 24 y/o male victim of a drive by shooting, sustaining a through and through gun shot wound to the Right mid thigh.
- He was reported to have a large amount of bright red pulsatile blood at the scene
- He was initially taken to a small community hospital without an in-house surgeon where his blood pressure was 80/50 and his heart rate was 140, and he was reported to have a markedly swollen thigh with active bleeding and no distal pulses. There are no other injuries.
- At the outside hospital a tourniquet was placed and he received 3000 cc of crystalloid and he is transferred to your facility now more than four hours after the injury on low dose norepinephrine with a blood pressure of 100/70 and a HR of 130, with a markedly swollen thigh and absent distal pulses.



Teaching Objectives/Steps:

1. Identify landmarks for exposing the femoral artery
a. Pubic tubercle, Anterior Superior Iliac crest
b. Inguinal Ligament

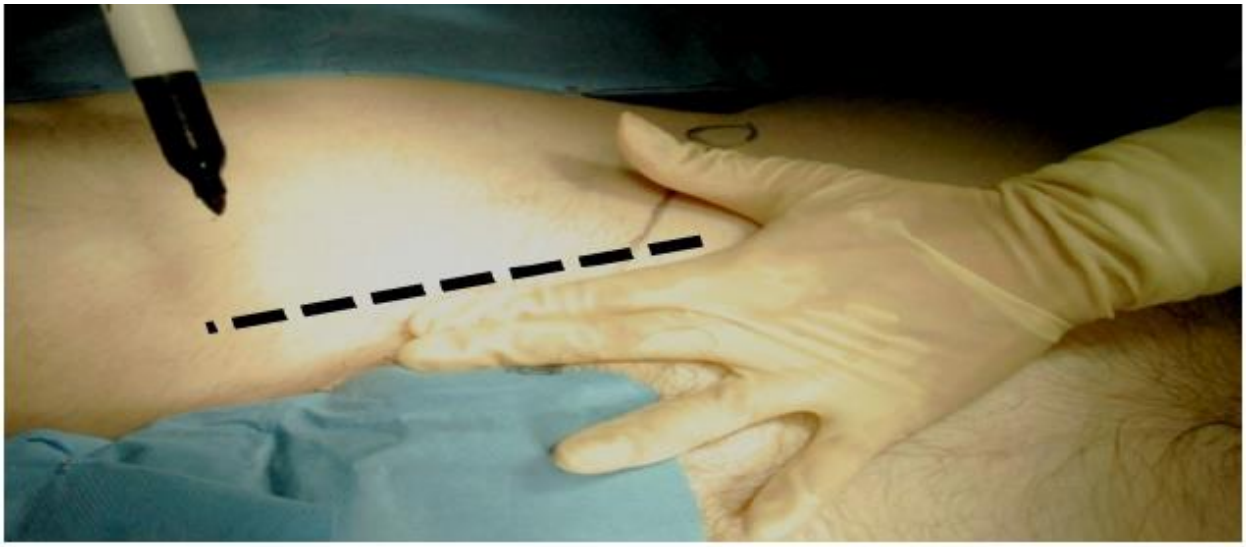
2. Have students cut down on Femoral artery
a. Incision directly over artery (using above landmarks) from above Inguinal Ligament to several inches below.
b. Open Femoral sheath on top of artery exposing common femoral and bifurcation
c. Deep dissection of the artery should be lateral to the saphenous vein and inguinal nodes

3. Identify/discuss following structures:
a. Relationship of Nerve, Artery, Vein, and Lymphatics
b. Circumflex iliac vessels

4. Expose Profunda and Superficial Femoral Artery
a. Proximal control of the profunda (place sling around origin of artery)

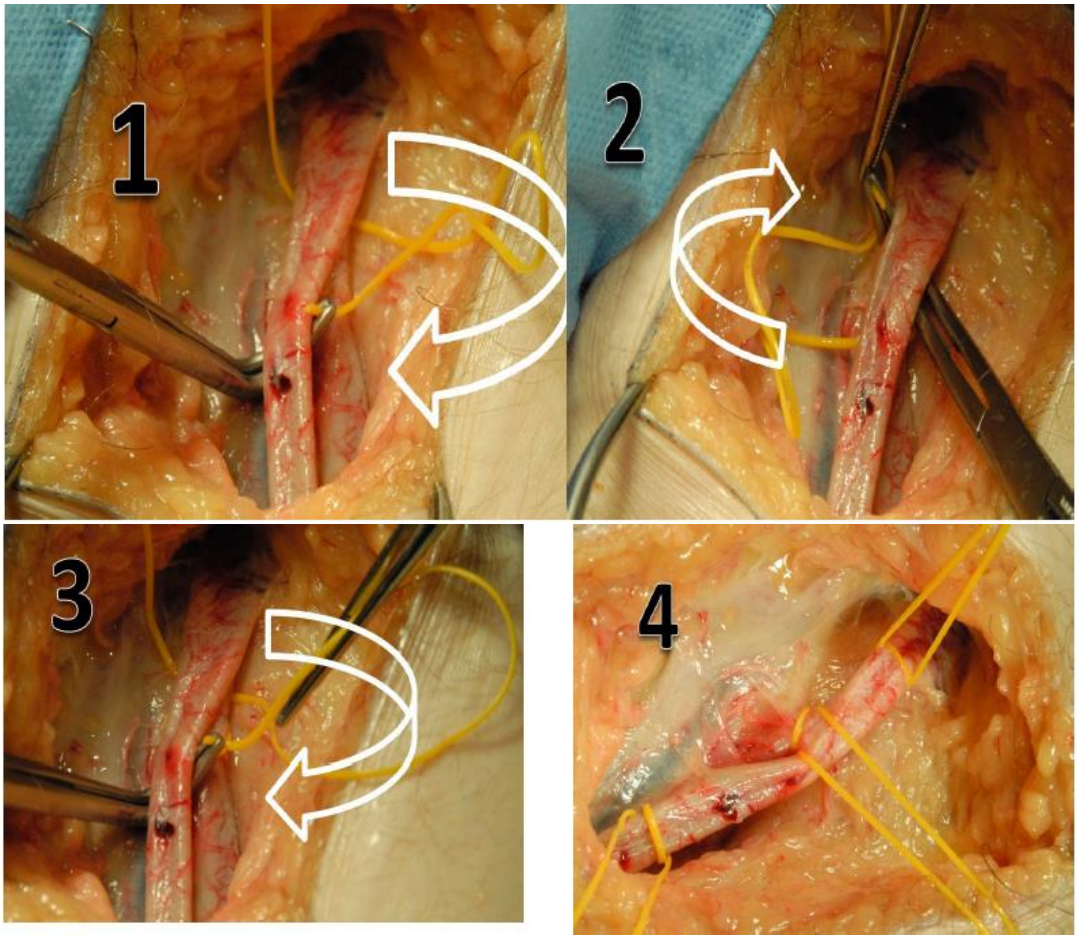
5. Expose several inches of SFA in the thigh.

Exposure of the Femoral Artery at the Groin:



Incision to expose Left Femoral Artery, opening femoral sheath on top of artery

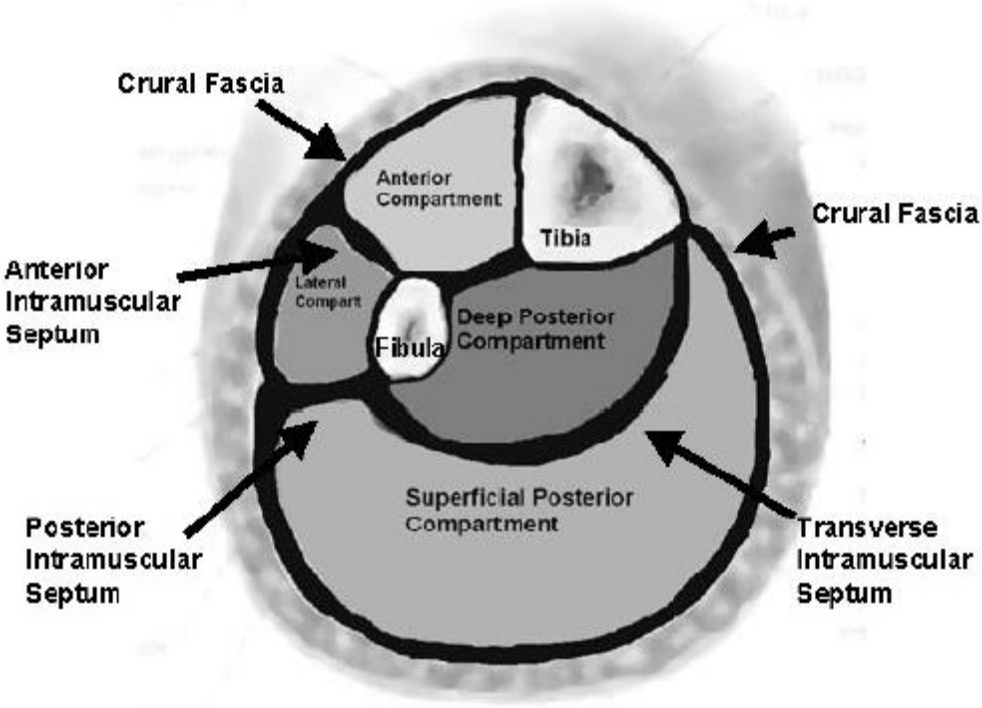
Proximal Control of the Profunda Artery:

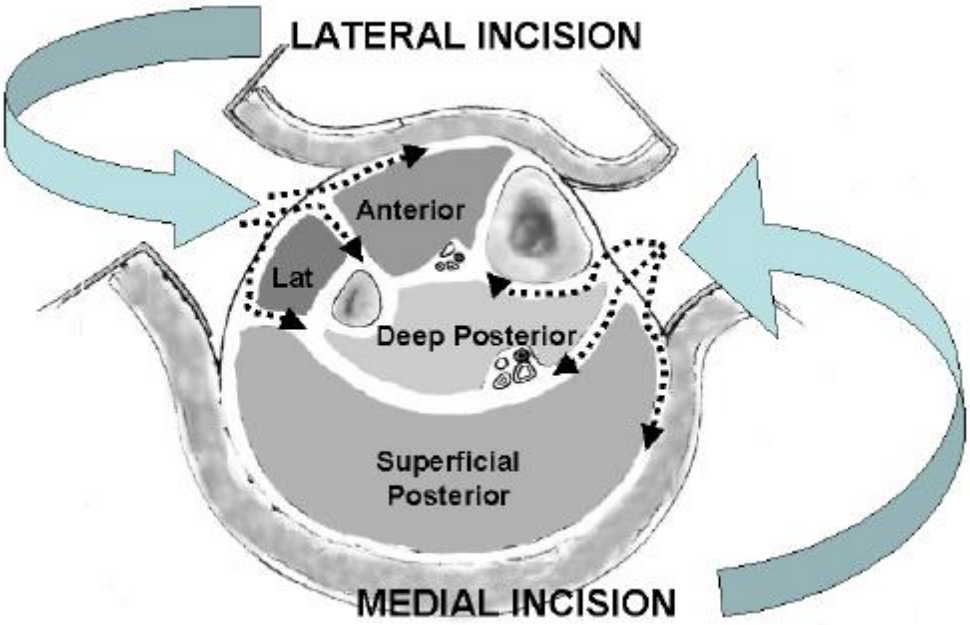


ASSET Case Four: Fasciotomy of the Lower Extremity (Two Incision – Four Compartment Fasciotomy)

Teaching Objectives/Steps:

1. Review the anatomy of the compartments of the lower leg and the landmarks for incisions.



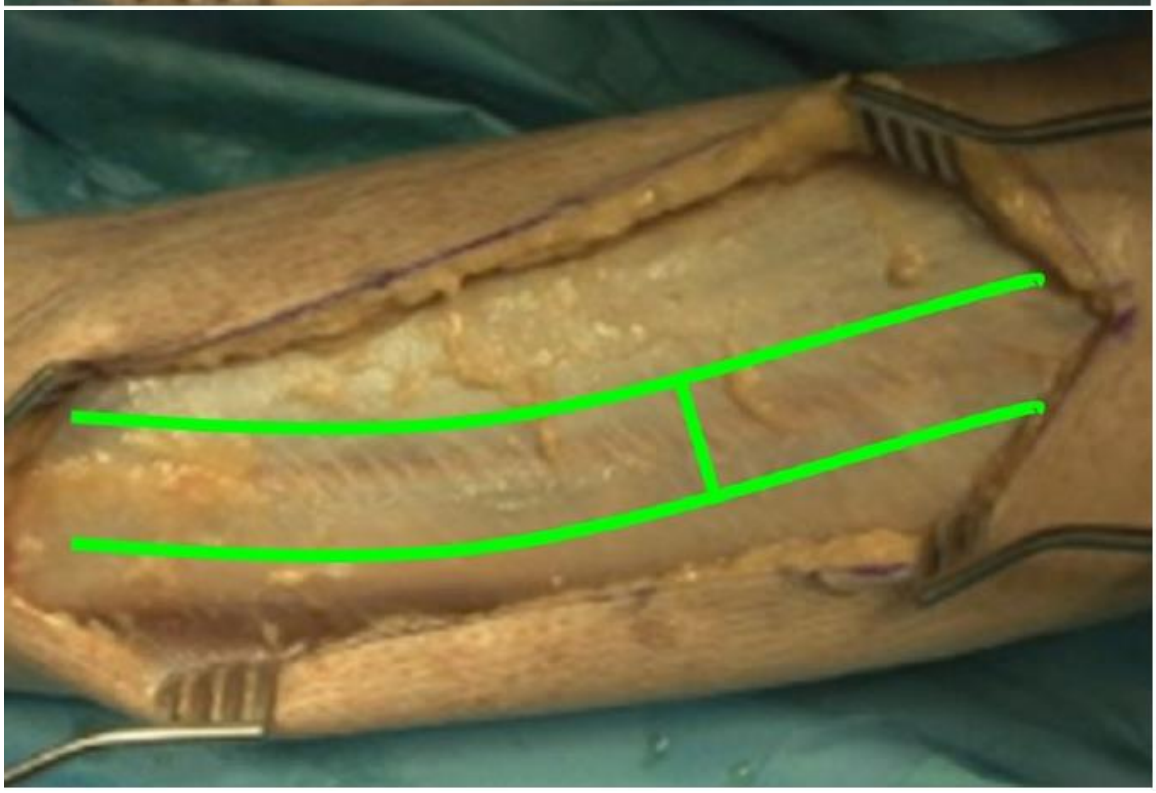


2. Perform Lateral Incision:

a. One finger in front of the fibula

b. Identify Intramuscular Septum

c. H-Shaped incision, extent of fasciotomy and skin incisions



3. Perform Medial Incision

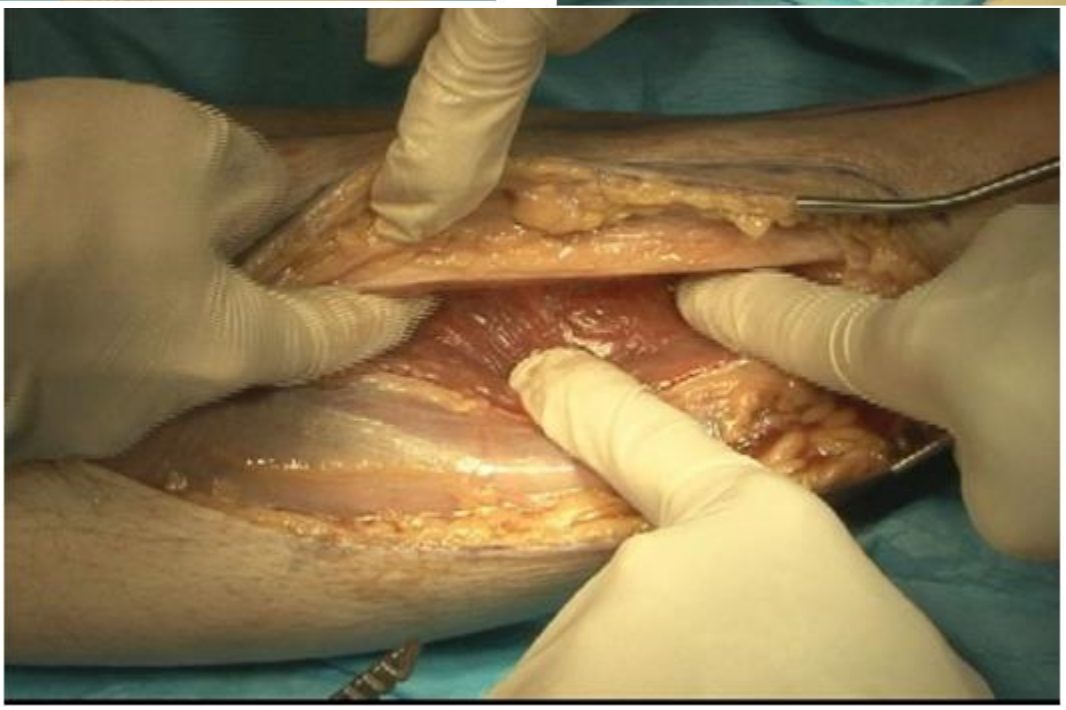
a. One *Thumb behind the Tibia*

b. Identify & preserve the Saphenous Vein

c. Enter Deep posterior compartment by taking down the soleus fibers

d. Identification of neurovascular bundle confirms entry into deep posterior compartment

e. Extent of fasciotomy and skin incisions.



Debrief of Pearls and Pitfalls Lower Extremity Fasciotomy

a. Diagnosis of Compartment syndrome may be delayed or missed entirely.

b. Skin incision not extend far enough superiorly or inferiorly or may not be placed in the correct position.

c. Fasciotomy may not be completed. Incision of the fascial tissue may not extend far enough superiorly or inferiorly.

d. The anterior and posterior deep compartments are the most often missed compartments.

Section II: Evaluation Instructions and Surgical Technical Skills Definitions

Evaluation Instructions –

Each evaluation sheet is comprised of four sections: 1) Global evaluation – allows you to provide your overall sense of performance for each procedure; 2) Surgical Technique points – allows you to score surgical skills/technique; 3) Surgical task points – allows you to score whether the participant has completed the necessary steps to adequately perform each procedure and 4) Expert Discriminatory sections – allows you to further define behaviors that denote either an expert or novice surgeon.

In addition, we ask you to fill out the date on which you evaluated the procedure, the video file number (if applicable) and your initials. At the end of the sheet there is also a section to provide further information such as a description of cadaver body habitus and whether the cadaver had normal or variant anatomy.

The Global Ratings:

1) Provides several pre-selected possibilities (linked to a Likert Scale) that ranks the surgeons technical performance of the RASP procedure that you are evaluating. Select the description that best identifies your evaluation of the participants surgical skill level.

2) Complete Overall Global Rating score (as a percentage) that reflects your judgment of the participants' surgical technical skills.

Surgical Technique:

1) Scored using the 1-5 scale linked with descriptors {(5) Every time (4) Almost every time (3) Sometimes (2) Occasionally (1) Never} shown at the bottom of the page. There is also an option to document if certain skulls were unable to be determined (UTA).

2) In general, each technique point describes either a preferred or unwanted behavior. The Likert Scale ranks how often the individual repeats that behavior during the procedure, in descending order.

Completion of Surgical Tasks (Yellow Heading Bar):

1) Evaluate each of the tasks identified for the procedure as yes/no if completed or UTA if Unable to Assess.

Surgical Technical Skill in the Operative Field:

1) This section details surgical skill associated with the skin incision, use of the entirety of the surgical field and how the surgeon's operating shifts throughout the operating field in a logical and systematic manner that infers intimate knowledge of the relevant anatomy.

Technical Skill in Instrument Use

1) This evaluation highlights aspects of surgical skill related to instrument use and choices e.g. how the instruments are held, how they are applied to the operating field, and how often and appropriate are the changes in instruments.

Evaluation Sheet Examples

AXILLARY ARTERY EXPOSURE GLOBAL RATING (circle one)**:**

Technical Skills for Exposing Axillary Artery:

1	2	3	4	5	UTA*
The participant's technical skills were well below expected with much wasted moves and very poor tissue handling.	The participant demonstrated below average technical skills with lots of wasted movements and errors in tissue handling.	The participant demonstrated average technical skills with some wasted movements and errors in tissue handling.	The participant demonstrated very good technical skills with minimal wasted movements and errors in tissue handling.	The participant demonstrated superior technical skills with no wasted movements and proper respect for tissues.	

Overall Understanding of the Surgical Anatomy of the Axillary Region:

1	2	3	4	5	UTA*
Inadequate knowledge of the regional anatomy. Unable to identify major structures and their relationships.	Knowledge of regional anatomy is below average. Can name most of the major structures but, requires some prompting.	Average understanding of the anatomy. May not be able to immediately point out or name all of the structures but can do so with minimal prompting.	Above average understanding of anatomy. Able to point out all of the relevant structures without prompting.	Superior grasp of anatomy and knows the minutia. Should be teaching anatomy class.	

This participant is ready to perform exposure and control the Axillary Artery:

1	2	3	4	5	UTA*
Take me to another hospital please!	This participant could do the exposure fine with experienced help, but will struggle if left alone.	The participant might need to look at a text to refresh their memory but will be able to perform the exposure.	This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.	Absolutely, I hope that this individual is on call if I am injured.	

Overall rating (1-100):

Body Habitus of cadaver (circle): Obese Average Thin

Cadaver Anatomy (circle): Normal Variant

***UTA** (Unable to Assess): The detail for this determination was not possible from the video

EXPOSURE OF AXILLARY DATE INITIALS: VIDEO FILE #:

*Technique points	Score 1-5	UTA
Exposes arteries by dissecting directly on anterior surface		
Manipulates artery by grasping adventitia		
Uses instruments properly		
Positions body to use instruments to best advantage		
Proceeds at appropriate pace with economy of movement		
Handles tissue well with minimal damage		
Creates an adequate visual field for procedure		
Communicates clearly and consistently		
Performs procedure without unnecessary dissection		
Continually progresses towards the end goal		

Surgical tasks for Axillary A. exposure	Yes	No	UTA
Initial skin incision is adequate to perform exposure			
Splitting or dividing Pectoralis Major			
Identification of Pectoralis Minor			
Division of the Pectoralis Minor			
Correctly identifies Axillary Artery			
Correctly identifies Axillary Vein			
Correctly identifies brachial plexus			
Controls the Axillary artery proximal to injury			

Error: Incorrectly identifies the Axillary artery and does not recognize or correct error	
Error: Incorrectly identifies the Axillary artery but is able to recognize and correct	

***Technique point Score 1-5: (5) Every time (4) Almost every time (3) Sometimes (2) Occasionally (1) Never**

Expert Discriminator Operative Field Maneuvers for Axillary Artery Exposure

	Yes	No
Operates through 'key-hole' or too small a skin incision		
Operates through incision-space		
Excessive dissection		
Pointless digging and shifting around in surgical field		
Has a logical operating sequence		
Lacks anatomical knowledge		

Expert Discriminatory Instrument Use for Axillary Artery Exposure

	Yes	No
Improper instrument use (e.g. back-handed use)		
Incorrect instrument holding (e.g. forceps too near tips, thumb through scissors handle)		
Scalpel use: multiple tentative cuts or cuts tangentially		
Switches instruments more than you would		
Uses scissors less than you would		
Dedicated use of a single instrument.		

BRACHIAL ARTERY EXPOSURE GLOBAL RATING (circle one)**:**

Technical Skills for Exposing Brachial Artery:

1	2	3	4	5	UTA*
The participant's technical skills were well below expected with much wasted moves and very poor tissue handling.	The participant demonstrated below average technical skills with lots of wasted movements and errors in tissue handling.	The participant demonstrated average technical skills with some wasted movements and errors in tissue handling.	The participant demonstrated very good technical skills with minimal wasted movements and errors in tissue handling.	The participant demonstrated superior technical skills with no wasted movements and proper respect for tissues.	

Overall Understanding of the Surgical Anatomy of the Brachial Region:

1	2	3	4	5	UTA*
Inadequate knowledge of the regional anatomy. Unable to identify major structures and their relationships.	Knowledge of regional anatomy is below average. Can name most of the major structures but, requires some prompting.	Average understanding of the anatomy. May not be able to immediately point out or name all of the structures but can do so with minimal prompting.	Above average understanding of anatomy. Able to point out all of the relevant structures without prompting.	Superior grasp of anatomy and knows the minutia. Should be teaching anatomy class.	

This participant is ready to perform exposure and control the Brachial Artery:

1	2	3	4	5	UTA*
Take me to another hospital please!	This participant could do the exposure fine with experienced help, but will struggle if left alone.	The participant might need to look at a text to refresh their memory but will be able to perform the exposure.	This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.	Absolutely, I hope that this individual is on call if I am injured.	

Overall rating (1-100):

Body Habitus of cadaver (circle): Obese Average Thin

Cadaver Anatomy (circle): Normal Variant

***UTA** (Unable to Assess): The detail for this determination was not possible from the video

EXPOSURE OF BRACHIAL DATE INITIALS: VIDEO FILE #:

*Technique points	Score 1-5	UTA
Exposes arteries by dissecting directly on anterior surface		
Manipulates artery by grasping adventitia		
Uses instruments properly		
Positions body to use instruments to best advantage		
Proceeds at appropriate pace with economy of movement		
Handles tissue well with minimal damage		
Creates an adequate visual field for procedure		
Communicates clearly and consistently		
Performs procedure without unnecessary dissection		
Continually progresses towards the end goal		

Surgical tasks for Brachial A. exposure	Yes	No	UTA
Initial skin incision is adequate to perform exposure			
Identifies Biceps and Triceps muscle			
Create plane of dissection between the Bicep and Triceps			
Correctly identifies Median Nerve			
Retracts and protects Median Nerve			
Correctly identifies Brachial Artery			
Dissects Brachial Artery away from venae comites			
Controls Brachial Artery with vessel loop			

Error: Incorrectly identifies the Brachial artery and does not recognize or correct error	
Error: Incorrectly identifies the Brachial artery but is able to recognize and correct	

***Technique point Score 1-5: (5) Every time (4) Almost every time (3) Sometimes (2) Occasionally (1) Never**

Expert Discriminator Operative Field Maneuvers for Brachial Artery Exposure

	Yes	No
Operates through 'key-hole' or too small a skin incision		
Operates through incision-space		
Excessive dissection		
Pointless digging and shifting around in surgical field		
Has a logical operating sequence		
Lacks anatomical knowledge		

Expert Discriminatory Instrument Use for Brachial Artery Exposure

	Yes	No
Improper instrument use (e.g. back-handed use)		
Incorrect instrument holding (e.g. forceps too near tips, thumb through scissors handle)		
Scalpel use: multiple tentative cuts or cuts tangentially		
Switches instruments more than you would		
Uses scissors less than you would		
Dedicated use of a single instrument.		

FEMORAL ARTERY EXPOSURE GLOBAL RATING (circle one)**:**

Technical Skills for Exposing Femoral Artery:

1	2	3	4	5	UTA*
The participant's technical skills were well below expected with much wasted moves and very poor tissue handling.	The participant demonstrated below average technical skills with lots of wasted movements and errors in tissue handling.	The participant demonstrated average technical skills with some wasted movements and errors in tissue handling.	The participant demonstrated very good technical skills with minimal wasted movements and errors in tissue handling.	The participant demonstrated superior technical skills with no wasted movements and proper respect for tissues.	

Overall Understanding of the Surgical Anatomy of the Femoral Region:

1	2	3	4	5	UTA*
Inadequate knowledge of the regional anatomy. Unable to identify major structures and their relationships.	Knowledge of regional anatomy is below average. Can name most of the major structures but, requires some prompting.	Average understanding of the anatomy. May not be able to immediately point out or name all of the structures but can do so with minimal prompting.	Above average understanding of anatomy. Able to point out all of the relevant structures without prompting.	Superior grasp of anatomy and knows the minutia. Should be teaching anatomy class.	

This participant is ready to perform exposure and control the Femoral Artery:

1	2	3	4	5	UTA*
Take me to another hospital please!	This participant could do the exposure fine with experienced help, but will struggle if left alone.	The participant might need to look at a text to refresh their memory but will be able to perform the exposure.	This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.	Absolutely, I hope that this individual is on call if I am injured.	

Overall rating (1-100):

Body Habitus of cadaver (circle): Obese Average Thin

Cadaver Anatomy (circle): Normal Variant

***UTA** (Unable to Assess): The detail for this determination was not possible from the video

EXPOSURE OF FEMORAL DATE INITIALS: VIDEO FILE #:

*Technique points	Score 1-5	UTA
Exposes arteries by dissecting directly on anterior surface		
Manipulates artery by grasping adventitia		
Uses instruments properly		
Positions body to use instruments to best advantage		
Proceeds at appropriate pace with economy of movement		
Handles tissue well with minimal damage		
Creates an adequate visual field for procedure		
Communicates clearly and consistently		
Performs procedure without unnecessary dissection		
Continually progresses towards the end goal		

Surgical tasks for Femoral A. exposure	Yes	No	UTA
Initial skin incision is adequate to perform exposure			
Correctly identifies Common Femoral Artery			
Correctly identifies Common Femoral Vein			
Correctly identifies Profunda Femoral Branch			
Correctly identifies Superficial Femoral Artery			
Controls Common Femoral Artery with vessel loop			
Controls Profunda Femoral Artery with vessel loop			
Controls Superficial Femoral Artery with vessel loop			

Error: Incorrectly identifies the CFA, SFA, or PFA and does not recognize or correct error	
Error: Incorrectly identifies the CFA, SFA, or PFA but is able to recognize and correct	

***Technique point Score 1-5: (5) Every time (4) Almost every time (3) Sometimes (2) Occasionally (1) Never**

Expert Discriminator Operative Field Maneuvers for Femoral Artery Exposure

	Yes	No
Operates through 'key-hole' or too small a skin incision		
Operates through incision-space		
Excessive dissection		
Pointless digging and shifting around in surgical field		
Has a logical operating sequence		
Lacks anatomical knowledge		

Expert Discriminatory Instrument Use for Femoral Artery Exposure

	Yes	No
Improper instrument use (e.g. back-handed use)		
Incorrect instrument holding (e.g. forceps too near tips, thumb through scissors handle)		
Scalpel use: multiple tentative cuts or cuts tangentially		
Switches instruments more than you would		
Uses scissors less than you would		
Dedicated use of a single instrument.		

LOWER EXTREMETY FASCIOTOMY GLOBAL RATING (circle one)**:**

Technical Skills for Displayed by participant during Fasciotomy:

1	2	3	4	5	UTA*
The participant's technical skills were well below expected with much wasted moves and very poor tissue handling.	The participant demonstrated below average technical skills with lots of wasted movements and errors in tissue handling.	The participant demonstrated average technical skills with some wasted movements and errors in tissue handling.	The participant demonstrated very good technical skills with minimal wasted movements and errors in tissue handling.	The participant demonstrated superior technical skills with no wasted movements and proper respect for tissues.	

Overall Understanding of the Surgical Anatomy required for performing Fasciotomy of the lower extremity:

1	2	3	4	5	UTA*
Inadequate knowledge of the regional anatomy. Unable to identify major structures and their relationships.	Knowledge of regional anatomy is below average. Can name most of the major structures but, requires some prompting.	Average understanding of the anatomy. May not be able to immediately point out or name all of the structures but can do so with minimal prompting.	Above average understanding of anatomy. Able to point out all of the relevant structures without prompting.	Superior grasp of anatomy and knows the minutia. Should be teaching anatomy class.	

This participant is ready to perform a two incision four compartment Fasciotomy of the lower extremity:

1	2	3	4	5	UTA*
Take me to another hospital please!	This participant could do the exposure fine with experienced help, but will struggle if left alone.	The participant might need to look at a text to refresh their memory but will be able to perform the exposure.	This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.	Absolutely, I hope that this individual is on call if I am injured.	

Overall rating (1-100):

Body Habitus of cadaver (circle): Obese Average Thin

Cadaver Anatomy (circle): Normal Variant

***UTA** (Unable to Assess): The detail for this determination was not possible from the video

LOWER EXTREMITY FASCIOTOMY DATE: INITIALS: VIDEO FILE #:

LATERAL leg incision landmarks:	Yes	No	UTA
The lateral Incision is marked one-two fingers in front of the fibula (1.5-3.0 cm)			
Upper end of incision 2-3 fingers (3.0-6.0 cm) from tibial plateau (TP)			
Lower end of incision 2-3 fingers (3.0-6.0 cm) from Lat. malleolus			

MEDIAL leg incision landmarks:	Yes	No	UTA
The Medial Incision is marked one Thumb behind the tibia (1.0-3.0 cm)			
Upper end of incision 2-3 fingers (3.0-6.0 cm) from tibial plateau (TP)			
Lower end of incision 2-3 fingers (3.0-6.0 cm) from Med. malleolus			

LATERAL Incision surgical tasks	Yes	No	UTA
Identifies Intermuscular septum			
Mentions perforating vessels as way to find IM septum			
Correctly identifies anterior and lateral compartments			
Uses "H-Shaped" incision to open fascia			
Under-runs fascia with closed scissor tips			
Opens fascia with partially closed scissor tips			
Points tips of scissors away from septum			
Relates necessity to avoid injury to underlying nerves			
Opens fascia over anterior compartment completely, within 3 cm of fibular head and lateral maleolus			
Opens fascia over lateral compartment completely			

MEDIAL Incision surgical tasks	Yes	No	UTA
Identifies and relates need to preserve greater saphenous vein and to ligate tributaries			
Correctly identify superficial posterior compartment (SPC)			
Opens entire length of fascia over superficial post compartment, within 3 cm of tibial plateau and medial maleolus			
Identifies contents of SPC:			
gastrocnemius			
soleus muscles			
Takes down soleus fibers from underside of tibia to enter Deep Post Compartment (DPC)			
Identifies the neurovascular bundle in the DPC			

Technique Points	Score 1-5	UTA
Uses instruments properly		
Positions body to use instruments to best advantage		
Proceeds at appropriate pace with economy of movement		
Creates an adequate visual field for procedure		
Communicates clearly and consistently		
Performs procedure without unnecessary dissection		
Continually progresses towards the end goal		

Error: Incorrectly identifies the intermuscular septum and does not recognize or correct error	
Error: Incorrectly identifies the intermuscular septum, but is able to recognize and correct	
Error: Fails to open compartments along the entire length	
Error: Fails to decompress the deep posterior compartment	
Error: Fails to decompress the anterior compartment	

***Technique point Score 1-5: (5) Every time (4) Almost every time (3) Sometimes (2) Occasionally (1) Never**

Expert Discriminator Operative Field Maneuvers for Lower Extremity Fasciotomy

	Yes	No
Operates through 'key-hole' or too small a skin incision		
Operates through incision-space		
Excessive dissection		
Pointless digging and shifting around in surgical field		
Has a logical operating sequence		
Lacks anatomical knowledge		

Expert Discriminatory Instrument Use for Lower Extremity Fasciotomy

	Yes	No
Improper instrument use (e.g. back-handed use)		
Incorrect instrument holding (e.g. forceps too near tips, thumb through scissors handle)		
Scalpel use: multiple tentative cuts or cuts tangentially		
Switches instruments more than you would		
Uses scissors less than you would		
Dedicated use of a single instrument.		

Technique Point Definitions

Exposes artery by dissecting directly on anterior surface:
Participant will use sharp dissection (eg Metz or scalpel) to incise the fascia and adventitia on the anterior surface of the artery thus avoiding smaller arteries that branch from the sides of the artery.

Manipulates artery by grasping adventitia:
The participant will use forceps to gently pull on or manipulate vascular structures by the adventitia. This will allow the participant to manipulate the artery, gaining an advantageous position for dissection. Any forceful movement or grasping of vascular tissue proper is considered incorrect.

Uses instruments properly:
Of the instruments used, this section will discuss proper handling of the 10 blade scalpel, Metzenbaum scissors, surgical forceps and Weitlaner retractors. The scalpel should be held similarly to a pencil between the thumb and second finger with the forefinger guiding it. Curved Metz should be held so that the curve is facing the same direction as the palmar surface of the participant's hand. The fingers should not be fully inserted within the handles of the scissors allowing for finer dexterous control. In addition, while using instruments such as Metz scissors or right angle forceps the participant should not situate themselves so that there arm and hand are contorted into a "back-handed" position. Forceps should not be held too close to the teeth. Weitlaner retractors should be quickly placed creating a larger area of exposure. Prolonged placement and repeated movement of retractors is considered incorrect.

Positions body to best advantage:
The participant should recognize their ability to relocate in relation to the cadaver in order to gain the most advantageous position for dissection. Back-handed use of surgical instruments is an indication of poor body position.

Proceeds at appropriate pace with economy of movement:
The objective of these surgical procedures is to gain immediate access and control of the artery thus avoiding unnecessary blood loss. Any hesitation during exposure or unconfident movement is considered to an inefficient pace. Any purposeless dissection is also considered inefficient. Instead, once the participant has gained access to the vessel no time is wasted identifying it and placing a loop around it immediately.

Creates an adequate visual field:
The participant is aware of the appropriate anatomical landmarks and is aware of the most efficient area to begin dissection and exposure. The initial incision is of correct length and placement so that the participant is not dissecting in a "hole" or the wrong area. Other ways to create an adequate visual field are effective use of retractors and correct positioning of the patient.

Communicates clearly and consistently:
In the beginning of each procedure the participant is told to keep a rolling narrative that describes their dissection process and the logic behind it. Prolonged silence or inadequate definition is considered to be incorrect.

Performs procedure without unnecessary dissection:
Time should not be wasted by the participant identifying anatomical structures or dissecting too cautiously.

Continually progresses towards the end goal:
This technique really looks at the procedure as a whole. The participant uses their clinical and anatomical knowledge to quickly decide where the most appropriate area is to begin dissection, the initial skin incision is an adequate length (meaning that they can gain access to the artery immediately), once surgery begins they immediately identify and loop the artery all while using appropriate surgical instruments that are available to them.

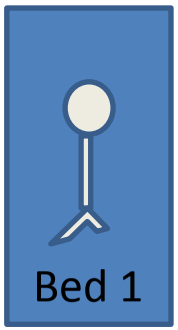
Phase 2 PRE Scenario

Rules of the scenario:

- **2 sessions/day (AM & PM); 1 Trial/day (1st Trial)**
- Each cadaver must be used twice.
- 1 cadaver/participant during each session

6 Participants
3 Evaluators
3 Script

3 cadavers
3 pans
0 models



AM 1st Trial
ca. 2 hours

Participant 1a
E-Team 1

Participant 2a
E-Team 2

Participant 3a
E-Team 3

PM 1st Trial
ca. 2 hours

Participant 4p
E-Team 1

Participant 5p
E-Team 2

Participant 6p
E-Team 3

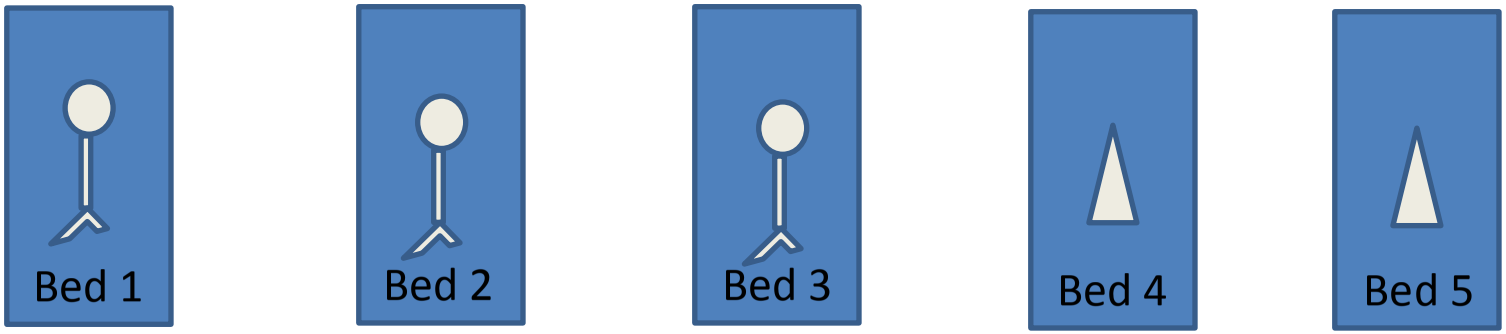
Phase 2 POST Scenario

6 Participants
3 Evaluators
3 Script

3 cadavers
3 pans
6 models

Rules of the scenario:

- **2 sessions/day (AM & PM); 2 Trials/session (1st and 2nd)**
- 3 participants, 3 E-Teams, and 3 beds operational per trial
- 3 participants must start on cadavers & 3 must start on models
- Each participant must have 1 trial with cadaver and 1 with model
- No participant can be at the same bed or with the same E-Team for both trials
- Cadaver beds must stay cadaver beds (Cadaver must be used twice, but may *not* be used at the same time).



AM 1st Trial
Ca. 2 hours

Participant 1a — *E-Team 1*
Participant 2a — *E-Team 2*
Participant 3a — *E-Team 3*

AM 2nd Trial
Ca. 1.5 hours

Participant 3a — *E-Team 3*
Participant 1a — *E-Team 1*
Participant 2a — *E-Team 2*

PM 1st Trial
Ca. 2 hours

Participant 4p — *E-Team 3*
Participant 5p — *E-Team 1*
Participant 6p — *E-Team 2*

PM 2nd Trial
Ca. 1.5 hours

Participant 5p — *E-Team 1*
Participant 6p — *E-Team 2*
Participant 4p — *E-Team 3*

Using only small portion of incision space and “Keyhole” Surgery

Inappropriate Incision: Lack of AA procedure anatomy knowledge

“Back-handedness” Instrument use

Inappropriate incision: Lack of Femoral Art. anatomy knowledge. Incorrect knife holding

Inadequate length Medial FAS incision

“Keyhole” surgery Brachial Artery

Holding forceps near tips

“Pointless” digging

Using forceps to dissect

RASP study Instructions, 1st Trial

"You are here today to participate in a study during which we will evaluate your current knowledge and skills regarding the management of patients with certain traumatic injuries.

We will present you a total of four cases that will focus on dealing with specific traumatic injuries.

For each case, I will ask you to first describe:

1. The structures that you suspect might be injured.
2. The physical findings you would specifically look for.
3. The need for any additional studies and treatments.
4. The need for surgical intervention.

We will then transition to the patient being in the operating room and I will ask you to:

1. Describe how you would position and prep the patient for surgery.
2. Mark the key landmarks for your incision.
3. Perform the indicated procedure using the available instruments.
4. As you perform each procedure you will be asked to speak out loud, describing the steps as you perform them.
5. It is not necessary to rush through the procedure.
6. Once you start the procedure, I will try not to interrupt you.
7. Perform the procedure as you would in a live patient to allow accurate assessment of your surgical technique.
8. You will have 20 minutes to complete each indicated procedure. Time will begin at your first incision.

Do you have any questions before we proceed?

Name of Evaluator: **Date:**

Name of Candidate: **(Circle timing): Pre Post**

1st Trial

Circle type of trial: Cadaver / Model

Case One: Axillary Artery

Case Presentation:

- **You are called to the Emergency Department to see a 24 y/o male who was shot during an attempted robbery sustaining a single gunshot wound to the upper anterior lateral Right/Left Chest.**
- **He was reported to have a large amount of bright red blood at the scene, but is currently not bleeding.**
- **He is complaining of pain at the site of the wound and inability to move his arm.**

[Advance slide to show image of wound]
[Advance slide to continue narrative]

- **He is awake and talking with bilateral and equal breath sounds and a BP of 80/60 and a heart rate of 130 after 2 liters of lactated ringers**
- **There is a single wound as seen with no other obvious trauma and no "exit wound". His hand is cool and pale.**

Question #1. What are the structures you suspect could be injured along the path of the bullet?

Expected Answers checklist:

The participant described each of the following as potentially injured:		
	Yes	**No**
Axillary Artery		
Axillary Vein		
Brachial Plexus		
Lung		
Subclavian Artery		
Subclavian Vein		
Mediastinal structures		
Bones		

Question #2. What physical findings will you look for to help you decide which structures are injured? Include signs of vascular, thoracic, nerve, and bone injury.

Expected Answers checklist:

The participant describes each of the following physical findings and tests:		
	Yes	**No**
Decreased breath sounds		
Active arterial bleeding		
Enlarging or expanding Hematoma		
Absent distal pulses		
Distal Ischemia		
Bruit or palpable thrill		
- Indicates that any or all of above are “hard signs” of vascular injury		
Active venous bleeding		
Unequal blood pressure, decreased Brachial-Brachial Index		
Doppler pulses—diminished flow		
Sensory loss		
Loss of motor function – weakness, inability to move arm		
Bony instability, deformation, crepitus		
Sub-cutaneous air		
Tracheal deviation		

The patient's blood pressure is 85/65 and HR 110 and is unable to move his arm, has decreased sensation and absent brachial, radial, and ulnar pulses.

Question #3:

What additional studies would you perform to help you identify or rule out specific injuries in this patient?

Expected Answers checklist:

The participant described each of the following as additional studies		
	Yes	**No**
FAST exam to look for pericardial tamponade, hemothorax, pneumothorax		
Chest X-ray		
A marker (eg paperclip) is placed to mark wound prior to x-ray		
Error: Fails to obtain CXR		
CT of Chest (zero points)		
CT Angiogram (zero pts)		
Angiogram (zero points)		
Error: Inappropriate use of CT or Angio*		

All of the above tests are acceptable possible studies but the participant should clearly indicate these tests should only be done in a hemodynamically stable patient. Without this qualifier, performing any of these tests prior to taking this patient to the OR has potential for negative outcome & should result in negative value scoring.

***Scoring Note: no additional points are added for additional studies**

[Advance slide to show Chest x-ray]

A chest x-ray has been obtained and shows no evidence of hemo or pneumothorax. There is a bullet fragment adjacent to the mid-portion of the ipsilateral scapula just superficial to the skin of the back – In other words a bullet trajectory from front to back on the same side, which does NOT involve the thoracic cavity.

Now the BP is 89/69 HR is 110. There is no other obvious trauma and his hand is cool and pale.

Question #4:

Now that you have seen the wound, physical findings, and chest x-ray, what is your plan for this patient?

If the participant suggests a non-operative course – they should be informed that: **the patient is now in the operating room and needs exposure and control of the axillary artery.**

Expected Answers checklist:

The participant states the following plan		
	Yes	**No**
Patient should be taken urgently to the Operating room		
Error: Delay in going to the operating room		

Question #5:

What is your plan to resuscitate this patient? Include fluids or medications you would use during the initial resuscitation.

Expected Answers checklist:

The participant describes each of the following additional items the patient might receive:		
	Yes	**No**
Resuscitate with blood products		
Transfuse with high ratio of blood:FFP:platelets/ Massive transfusion protocol		
Minimize crystalloid infusion		
Limit volume resuscitation until bleeding controlled		
Do not delay surgery for resuscitation, resuscitate in OR		
Give TXA		
Large bore IV access		

The patient has now been transported to the Operating Room and is on the OR table in front of you.

Question OR # 1:

How would you position and prep this patient in order to repair this injury and explain why you chose to prep as you did?

Expected Answers checklist:

The participant Indicates the following in response:		
	Yes	**No**
The patient should be supine		
The arm extended on an arm board		

The prep should include:		
The Entire Chest		
States possible need for sternotomy for proximal control		
The Entire arm and hand on the affected side		
States need to evaluate perfusion to the hand		
The thigh/groin for possible vein harvest		
The neck		
States possible need to expose subclavian artery for proximal control		
Error: Fails to prep entire chest		
Error: Fails to prep entire arm and hand.		
Error: Fails to prep the thigh for vein harvest		

Question OR # 2:

At this time, please describe and then mark on the skin the landmarks and the incision that you plan to use.

Expected Answers checklist:

The participant Indicates the following in response:		
	Yes	**No**
The sternal notch		
The clavicle		
The deltopectoral groove		
Incision runs from mid-clavicle laterally in deltopectoral groove.		

EXPOSURE OF AXILLARY ARTERY

"Now I would like you to get control of the Axillary Artery proximal to the wound by dissecting and placing a vessel loop around the artery. As you operate, speak out loud and identify each step of the procedure. It is not necessary to rush through the procedure—you should operate at a comfortable pace. The procedure will be deemed complete once you have placed a vessel loop around the axillary artery to obtain proximal control. Do you have any questions? If not please proceed."

Expected operative dissection performance checklist:

The participant describes and performs each of the following steps:			
	Yes	**No**	**Time**
Initial skin incision is adequate to perform exposure			**Start Incision**
Splitting or dividing Pectoralis Major			**Start Dissection**
Divides Pectoralis Minor			
Correctly identifies Axillary Artery			
Correctly identifies Axillary Vein			
Correctly identifies brachial plexus			
Controls the Axillary Artery Proximal to injury			**Finish**
Error: Incorrectly identifies the Axillary artery and does not recognize or correct error			
Error: Incorrectly identifies the Axillary Artery but is able to recognize and correct			

Technique points

	Score 1-5
*Exposes arteries by dissecting directly on anterior surface**	
*Manipulates artery by grasping adventitia**	
Uses instruments properly	
Positions body to use instruments to best advantage	
Proceeds at appropriate pace with economy of movement	
Handles tissue well with minimal damage	
Creates an adequate visual field for procedure	
Communicates clearly and consistently	
Performs procedure without unnecessary dissection	
Continually progresses towards the end goal	

(5) Every time/Excellent; (4) Almost every time/Very good; (3) Sometimes/Good; (2) Rarely/Fair; (1) Never/Poor

*N/A for model

Expert Discriminator Operative Field Maneuvers for Axillary Artery Exposure

	Yes	No
Operates through 'key-hole' or too small a skin incision		
Operates using full incision		
Excessive dissection		
Pointless digging and shifting around in surgical field		
Has a logical operating sequence		
Lacks anatomical knowledge		

Expert Discriminatory Instrument Use for Axillary Artery Exposure

	Yes	No
Improper instrument use (e.g. back-handed use)		
Incorrect instrument holding (e.g. forceps too near tips, thumb through scissors handle)		
Scalpel use: multiple tentative cuts or cuts tangentially		
Switches instruments more than you would		
Uses scissors less than you would		
Dedicated use of a single instrument.		

Questions in OR, after dissection:

What are the consequences of ligating the axillary artery?

The participant answered the questions correctly:		
	Yes	No
Ligation of the axillary generally does not cause ischemia due to extensive collaterals around the shoulder.		

What are the pitfalls or common errors that one might expect with this procedure?

Possible Answers		
	Yes	No
Incision – too high, too low		
Iatrogenic injury to nerve, artery, vein		
Inability to get proximal control – needing to go above clavicle or into chest		
Diving into clot or hematoma without adequate control		
Mistaking nerve for artery		

AXILLARY ARTERY EXPOSURE GLOBAL RATING (circle one)**:**

Technical Skills for Exposing the Axillary Artery:

1	2	3	4	5
The participant's technical skills were poor with much wasted moves and very poor tissue handling.	The participant demonstrated fair technical skills with some wasted movements and errors in tissue handling	The participant demonstrated good technical skills with occasional wasted movements and errors in tissue handling.	The participant demonstrated very good technical skills with minimal wasted movements and errors in tissue handling.	The participant demonstrated excellent technical skills with no wasted movements and proper respect for tissues.

Overall Understanding of the Evaluation and Treatment of a Patient with a Suspected Axillary Artery Injury:

1	2	3	4	5
Core knowledge is poor and there is no evidence of understanding the nuances of evaluation and diagnosis.	Core knowledge is fair with some understanding of the nuances of evaluation and diagnosis.	Core knowledge is good with moderate understanding of the nuances of evaluation and diagnosis.	Core knowledge is very good with thorough understanding of the nuances of evaluation and diagnosis.	Core knowledge is excellent with a superior understanding of the nuances of evaluation and diagnosis.

Overall Understanding of the Surgical Anatomy of the Axillary Region:

1	2	3	4	5
Poor knowledge of the regional anatomy. Unable to identify major structures or their relationships.	Fair knowledge of regional anatomy. Can name some of the major structures and their relationships	Good understanding of the anatomy. Can name most of the major structures and their relationships.	Very good understanding of anatomy. Able to point out all of the major structures and their relationships.	Excellent understanding of the anatomy, including variants. Knows the minutia, Should be teaching anatomy class.

This participant is ready to perform exposure and control the Axillary Artery:

1	2	3	4	5
Take me to another hospital please!	This participant could do the exposure fine with experienced help, but will struggle if left alone.	The participant might need to look at a text to refresh their memory but will be able to perform the exposure.	This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.	Absolutely, I hope that this individual is on call if I am injured.

Evaluator's overall rating (1-100) _____

≥ 90 Excellent I hope that this individual is on call if I am injured
80-89 This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.
70-79 The participant might need to look at a text to refresh their memory but will be able to perform the exposure
60-69 This participant could do the exposure with experienced help, but will struggle if left alone
<60 Take me to another hospital please!

The overall score should be the instructor's subjective rating of how well the surgeon performed. This will be compared to the objective score for the purpose of validating the scoring method.

Body Habitus of cadaver (Circle):

Obese Average Thin

Cadaver Anatomy (Circe):

Normal Variant

Name of Evaluator: **Date:**

Name of Candidate: **(Circle timing): Pre Post**

1st Trial

Circle type of trial: Cadaver / Model

Case Two: Brachial Artery

Case Presentation

- **32 y/o male was accidentally shot in the arm at close range with a hunting rifle.**
- **He was reported to have had large pulsatile blood loss at the scene.**

[Advance slide to show image of wound]
[Advance slide to continue narrative]

- **There is active pulsatile bleeding from the medial wound which is currently being controlled with direct pressure by the paramedic.**
- **Distal pulses are absent.**
- **BP = 100/68, HR = 120**
- **There are no other injuries.**

Question #1:

What are the structures you suspect could be injured, including nerve, artery, vein, or other?

Expected Answers checklist:

The participant described each of the following as potentially injured:		
	Yes	**No**
Brachial Artery		
Median Nerve		
Radial Nerve		
Humerus		
Radius, Ulna		
Veins		

BP is 105/70 and HR is 110. The patient has no neurologic deficit, but has absent radial and ulnar pulses.

Question #2:

What additional studies would you perform to help you identify or rule out specific injuries in this patient?

Expected Answers checklist:

The participant described each of the following as additional studies		
	Yes	**No**
X-ray of arm		
Chest X-ray		
CT Angiogram (zero pts)		
Angiogram (zero points)		
Error: Inappropriate use of CT or Angio*		

All of the above tests are acceptable possible studies but the participant should clearly indicate these tests should only be done in a hemodynamically stable patient. Without this qualifier, performing any of these tests prior to taking this patient to the OR has potential for negative outcome & should result in negative value scoring.

***Scoring Note: no additional points are added for additional studies**

Arm X-ray shows no fracture and no retained fragments. Chest X-ray is normal (if ordered).

Question #3:

What is your plan for this patient?

If the participant persists in suggesting a non-operative course – they should be informed that **"the patient is now in the operating room."**

Expected Answers checklist:

The participant states the following plan		
	Yes	**No**
Patient should be taken urgently to the Operating room		
Error: Delay in going to the operating room		

The Patient has now been transported to the Operating Room and is on the OR table in front of you.

Question OR # 1:

How would you position and prep this patient in order to repair this injury and explain why you chose to prep as you did?

Expected Answers checklist:

The participant Indicates the following in response:		
	Yes	**No**
The patient should be supine		
The arm extended on an arm board		

The prep should include:		
The entire arm and hand on the affected side		
Mentions need to evaluate perfusion to the hand		
The Axilla on the affected side		
Mentions possible need to expose axillary artery for proximal control		
The thigh/groin for possible vein harvest		
Error: Fails to prep entire arm and hand.		
Error: Fails to prep the thigh for vein harvest		

Question OR # 2:

Can you describe how you plan to gain control of the bleeding vessel using general principles of vascular surgery?

Expected Answers checklist:

The participant indicates the following principles of vascular exposure:		
	Yes	**No**
Proximal control first		
Distal control second		
Expose injury		

Question OR # 3:

At this time, please describe and then mark on the skin the landmarks and the incision that you plan to use.

Expected Answers checklist:

The participant Indicates and marks the following landmarks:		
	Yes	**No**
The biceps and triceps		
The humerus		
Incision between biceps and triceps bellies		

EXPOSURE OF BRACHIAL ARTERY

"Now I would like you to surgically expose and control the Brachial Artery with a vessel loop in order to gain proximal control. As you operate, speak out loud and identify each step of the procedure. It is not necessary to rush through the procedure. The procedure will be deemed complete once you have placed a vessel loop around the Brachial artery to obtain proximal control. Do you have any questions? If not please proceed"

Expected operative dissection performance checklist:

The participant describes and performs each of the following steps:			
	Yes	**No**	**Time**
Initial skin incision is adequate to perform exposure			**Start Incision**
Creates a plane of dissection between the Biceps and Triceps			**Start Dissection**
Correctly identifies Median Nerve			
Retracts and protects Median Nerve			
Correctly identifies Brachial Artery			
Dissects Brachial Artery away from venae comites			
Controls Brachial artery with vessel loop proximal to the injury			**Finish**
Error: Incorrectly identifies the Brachial Artery and does not recognize or correct error			
Error: Incorrectly identifies the Brachial Artery but is able to recognize and correct			

Technique points

	Score 1-5
*Exposes arteries by dissecting directly on anterior surface**	
*Manipulates artery by grasping adventitia**	
Uses instruments properly	
Positions body to use instruments to best advantage	
Proceeds at appropriate pace with economy of movement	
Handles tissue well with minimal damage	
Creates an adequate visual field for procedure	
Communicates clearly and consistently	
Performs procedure without unnecessary dissection	
Continually progresses towards the end goal	

(5) Every time/Excellent; (4) Almost every time/Very good; (3) Sometimes/Good; (2) Rarely/Fair; (1) Never/Poor

*N/A for model

Expert Discriminator Operative Field Maneuvers for Brachial Artery Exposure

	Yes	No
Operates through 'key-hole' or too small a skin incision		
Operates using full incision		
Excessive dissection		
Pointless digging and shifting around in surgical field		
Has a logical operating sequence		
Lacks anatomical knowledge		

Expert Discriminatory Instrument Use for Brachial Artery Exposure

	Yes	No
Improper instrument use (e.g. back-handed use)		
Incorrect instrument holding (e.g. forceps too near tips, thumb through scissors handle)		
Scalpel use: multiple tentative cuts or cuts tangentially		
Switches instruments more than you would		
Uses scissors less than you would		
Dedicated use of a single instrument.		

Questions in OR, after dissection:

What are the consequences of ligating the brachial artery?

The participant answered the questions correctly:		
	Yes	No
Can ligate the brachial artery: ligation above the profunda results in limb loss in 50% of cases; below the profunda results in limb loss in 5% of cases		

What are the pitfalls or common errors that one might expect with this procedure?

Possible Answers		
	Yes	No
Incision – too anterior, too posterior		
Mistaking nerve for artery		
Iatrogenic injury to nerve, artery, vein		
Diving into clot or hematoma at the injury site without adequate control		

BRACHIAL ARTERY EXPOSURE GLOBAL RATING (circle one)**:**

Technical Skills for Exposing the Brachial Artery:

1	2	3	4	5
The participant's technical skills were poor with much wasted moves and very poor tissue handling.	The participant demonstrated fair technical skills with some wasted movements and errors in tissue handling	The participant demonstrated good technical skills with occasional wasted movements and errors in tissue handling.	The participant demonstrated very good technical skills with minimal wasted movements and errors in tissue handling.	The participant demonstrated excellent technical skills with no wasted movements and proper respect for tissues.

Overall Understanding of the Evaluation and Treatment of a Patient with a Patient with a suspected Brachial Artery Injury:

1	2	3	4	5
Core knowledge is poor and there is no evidence of understanding the nuances of evaluation and diagnosis.	Core knowledge is fair with some understanding of the nuances of evaluation and diagnosis.	Core knowledge is good with moderate understanding of the nuances of evaluation and diagnosis.	Core knowledge is very good with thorough understanding of the nuances of evaluation and diagnosis.	Core knowledge is excellent with a superior understanding of the nuances of evaluation and diagnosis.

Overall Understanding of the Surgical Anatomy of the Arm:

1	2	3	4	5
Poor knowledge of the regional anatomy. Unable to identify major structures or their relationships.	Fair knowledge of regional anatomy. Can name some of the major structures and their relationships	Good understanding of the anatomy. Can name most of the major structures and their relationships.	Very good understanding of anatomy. Able to point out all of the major structures and their relationships.	Excellent understanding of the anatomy, including variants. Knows the minutia, Should be teaching anatomy class.

This Participant is Ready to Perform Exposure and Control of the Brachial Artery and its Branches:

1	2	3	4	5
Take me to another hospital please!	This participant could do the exposure fine with experienced help, but will struggle if left alone.	The participant might need to look at a text to refresh their memory but will be able to perform the exposure.	This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.	Absolutely, I hope that this individual is on call if I am injured.

Evaluator's overall rating (1-100) _____

≥ 90 Excellent I hope that this individual is on call if I am injured
80-89 This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.
70-79 The participant might need to look at a text to refresh their memory but will be able to perform the exposure
60-69 This participant could do the exposure with experienced help, but will struggle if left alone
<60 Take me to another hospital please!

The overall score should be the instructor's subjective rating of how well the surgeon performed. This will be compared to the objective score for the purpose of validating the scoring method.

Body Habitus of cadaver (Circle):

Obese Average Thin

Cadaver Anatomy (Circe):

Normal Variant

Name of Evaluator: **Date:**

Name of Candidate: **(Circle timing): Pre Post**

1st Trial

Circle type of trial: Cadaver / Model

Case Three: Femoral Artery

Case History:

- **24 y/o male who was a victim of a drive by shooting, sustaining a through and through gunshot wound to the Right/Left mid-thigh**
- **He was reported to have a large amount of bright red pulsatile blood at the scene**
- **He was initially taken to a small community hospital without an in-house surgeon where his blood pressure was 80/50 and his heart rate was 140. He was reported to have a markedly swollen thigh with active bleeding and no distal pulses. There are no other injuries.**

[Advance slide to show image of wound]

[Advance slide to continue narrative]

- **At the outside hospital a tourniquet was placed and he received 3000 cc of crystalloid. He is transferred to your facility now more than four hours after the injury. He received low dose norepinephrine and has a blood pressure of 100/70 and a HR of 130, with a markedly swollen thigh and absent distal pulses.**

Question #1:

What are all the structures you suspect could be injured, including nerve, artery, vein, or other structure?

Expected Answers checklist:

The participant described each of the following as potentially injured:		
	Yes	**No**
Common Femoral Artery		
Common Femoral Vein		
Superficial Femoral Artery		
Superficial Femoral Vein		
Femoral Nerve/Branches		
Profunda Femoral Artery		
Femur		

Question #2:

What are the physical findings that may help you determine which structures are injured in this patient, including signs of vascular, nerve, and bone injury?

Expected Answers checklist:

The participant describes each of the following physical findings and tests:		
	Yes	**No**
Loss of Popliteal/DP/PT pulses		
Pulsatile bleeding		
Expanding hematoma		
Hemorrhagic shock		
Unstable femur or crepitance of bone		
Ankle-Ankle or Ankle-Brachial Index		
Neurologic deficits in femoral nerve distribution:		
Sensation to anterior thigh		
Motor to hip flexion, knee extension		

BP is 95/65 and HR is 125. The patient has a cool and pulseless foot, he is able to move the ankle and foot, but is unable to extend the knee. There is numbness on the anterior thigh.

Question #3:

What additional studies would you perform to help you identify or rule out specific injuries in this patient?

Expected Answers checklist:

The participant described each of the following as additional studies		
	Yes	**No**
X-ray of femur		
Chest X-ray (zero points)		
CT Angiogram (zero pts)		
Angiogram (zero points)		
Error: Inappropriate use of CT or Angio*		

All of the above tests are acceptable possible studies but the participant should clearly indicate these tests should only be done in a hemodynamically stable patient. Without this qualifier, performing any of these tests prior to taking this patient to the OR has potential for negative outcome & should result in negative value scoring.

***Scoring Note: no additional points are added for additional studies**

The femoral X-ray shows no fracture and no retained fragments. Chest X-ray is normal (if obtained).

If Sup Femoral artery injury has not been recognize—Tell the participant explicitly that the patient has an injury to the Superficial Femoral Artery.

Question #4:

What is your plan for this patient?

FYI: If the participant persists in suggesting a non-operative course – **Inform the participant that the patient is now in the operating room and needs exposure and control of the Femoral Artery.**

Expected Answers checklist:

The participant states the following plan		
	Yes	**No**
Patient should be taken urgently to the Operating room		
Error: Delay in going to the operating room		

Question #5:

What interventions are important to resuscitate and treat this patient before and during surgery?

Question #6:

What further management would you consider given the ischemic time which is already greater than 4 hours?

Expected Answers checklist:

The participant describes each of the following additional items the patient might receive:		
	Yes	**No**
Hemorrhagic Shock:		
Resuscitate with blood products		
Transfuse with high ratio of blood:FFP:platelets/ Massive transfusion protocol		
Wean off norepinephrine		
Minimize crystalloid		
Give TXA		
Reperfusion injury:		
Volume load		
Bicarbonate		
Monitor for arrhythmia		
Already lengthy ischemic time:		
Temporary vascular shunt		
Recognize need for fasciotomy		
Monitor for rhabdomyolysis		

The patient has now been transported to the Operating Room and is on the OR table in front of you.

Question OR # 1:

How would you position and prep this patient in order to repair this injury and explain why you chose to prep as you did?

Expected Answers checklist:

The participant Indicates the following in response:		
	Yes	**No**
The patient should be supine		
Leg externally rotated and knee supported		

The prep should include:		
The entire lower extremity, including foot on the affected side		
States need to assess perfusion to the foot		
States possible need for fasciotomy		
The thigh/groin on the contralateral side for possible vein harvest		
Error: Fails to prep entire lower extremity, including foot on effected side		
Error: Fails to prep the contralateral groin		

Question OR # 2:

At this time, please verbalize and then mark on the cadaver the landmarks and the incision that you will use on the skin.

Expected Answers checklist:

The participant Indicates and marks the following landmarks		
	Yes	**No**
Pubic tubercle		
Ant Sup iliac Spine (ASIS)		
Inguinal ligament		
Femoral artery (approximate location 1/3 of distance from pubic tubercle to ASIS)		
Marks longitudinal incision over femoral artery, 2 finger breadths lateral to the pubic tubercle		
Incision extends above inguinal ligament 4-5 cm		

EXPOSURE OF FEMORAL ARTERY

"At this time, I would like you to surgically explore and control the Common Femoral Artery, the Superficial Femoral Artery, and Profunda Femoral Artery. As you operate, speak out loud and identify each step of the procedure. It is not necessary to rush through the procedure. The procedure will be deemed complete once you have placed a double vessel loop around the Common Femoral, Superficial Femoral, and Profunda Femoral arteries to obtain proximal control. Do you have any questions? If not please proceed."

Expected operative dissection performance checklist:

The participant describes and performs each of the following steps:			
	Yes	**No**	**Time**
Initial skin incision is adequate to perform exposure			**Start Incision**
Correctly identifies Common Femoral Artery			**Start Dissection**
Correctly identifies Common Femoral Vein			
Correctly identifies Profunda Femoral Branch			
Correctly identifies Superficial Femoral Artery			
Controls Common Femoral Artery with vessel loop			
Controls Profunda Femoral Artery with vessel loop			
Controls Superficial Femoral Artery with vessel loop			**Finish**
Error: Incorrectly identifies the CFA, SFA, or PFA and does not recognize or correct error			
Error: Incorrectly identifies CFA, SFA, or PFA, but is able to recognize and correct			

Technique points

	Score 1-5
*Exposes arteries by dissecting directly on anterior surface**	
*Manipulates artery by grasping adventitia**	
Uses instruments properly	
Positions body to use instruments to best advantage	
Proceeds at appropriate pace with economy of movement	
Handles tissue well with minimal damage	
Creates an adequate visual field for procedure	
Communicates clearly and consistently	
Performs procedure without unnecessary dissection	
Continually progresses towards the end goal	

(5) Every time/Excellent; (4) Almost every time/Very good; (3) Sometimes/Good; (2) Rarely/Fair; (1) Never/Poor

*N/A for model

Expert Discriminator Operative Field Maneuvers for Femoral Artery Exposure

	Yes	No
Operates through 'key-hole' or too small a skin incision		
Operates using full incision		
Excessive dissection		
Pointless digging and shifting around in surgical field		
Has a logical operating sequence		
Lacks anatomical knowledge		

Expert Discriminatory Instrument Use for Femoral Artery Exposure

	Yes	No
Improper instrument use (e.g. back-handed use)		
Incorrect instrument holding (e.g. forceps too near tips, thumb through scissors handle)		
Scalpel use: multiple tentative cuts or cuts tangentially		
Switches instruments more than you would		
Uses scissors less than you would		
Dedicated use of a single instrument.		

Questions in OR, after dissection:

What are the consequences of ligating the Superficial Femoral artery? What are the consequences of ligating the Superficial Femoral vein?

The participant answered the questions correctly:		
	Yes	**No**
SFA results in severe limb ischemia /requires amputation		
SFV ligation may cause limb edema		

What are the pitfalls or common errors that one might expect with this procedure?

Possible Answers		
	Yes	**No**
Incision – too high, too low		
Iatrogenic injury to nerve, artery, vein		
Inability to get proximal control below the inguinal ligament		
Diving into clot or hematoma at the injury site without adequate proximal and distal control		
Mistaking nerve for artery		
Variable location of Profunda Femoral Artery or mistaking SFA for CFA		

FEMORAL ARTERY EXPOSURE GLOBAL RATING (circle one)**:**

Technical Skills for Exposing Common Femoral Artery and Branches:

1	2	3	4	5
The participant's technical skills were poor with much wasted moves and very poor tissue handling.	The participant demonstrated fair technical skills with some wasted movements and errors in tissue handling	The participant demonstrated good technical skills with occasional wasted movements and errors in tissue handling.	The participant demonstrated very good technical skills with minimal wasted movements and errors in tissue handling.	The participant demonstrated excellent technical skills with no wasted movements and proper respect for tissues.

Overall Understanding of the Evaluation and Treatment of a Patient with a Suspected Superficial Femoral Artery Injury:

1	2	3	4	5
Core knowledge is poor and there is no evidence of understanding the nuances of evaluation and diagnosis.	Core knowledge is fair with some understanding of the nuances of evaluation and diagnosis.	Core knowledge is good with moderate understanding of the nuances of evaluation and diagnosis.	Core knowledge is very good with thorough understanding of the nuances of evaluation and diagnosis.	Core knowledge is excellent with a superior understanding of the nuances of evaluation and diagnosis.

Overall Understanding of the Surgical Anatomy of the Inguinal Region:

1	2	3	4	5
Poor knowledge of the regional anatomy. Unable to identify major structures or their relationships.	Fair knowledge of regional anatomy. Can name some of the major structures and their relationships	Good understanding of the anatomy. Can name most of the major structures and their relationships.	Very good understanding of anatomy. Able to point out all of the major structures and their relationships.	Excellent understanding of the anatomy, including variants. Knows the minutia, Should be teaching anatomy class.

This Participant is ready to Perform Exposure and Control the Common Femoral Artery and Branches:

1	2	3	4	5
Take me to another hospital please!	This participant could do the exposure fine with experienced help, but will struggle if left alone.	The participant might need to look at a text to refresh their memory but will be able to perform the exposure.	This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.	Absolutely, I hope that this individual is on call if I am injured.

Evaluator's overall rating (1-100) _____

≥ 90 Excellent I hope that this individual is on call if I am injured
80-89 This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.
70-79 The participant might need to look at a text to refresh their memory but will be able to perform the exposure
60-69 This participant could do the exposure with experienced help, but will struggle if left alone
<60 Take me to another hospital please!

The overall score should be the instructor's subjective rating of how well the surgeon performed. This will be compared to the objective score for the purpose of validating the scoring method.

Body Habitus of cadaver (Circle):

Obese Average Thin

Cadaver Anatomy (Circe):

Normal Variant

Name of Evaluator: **Date:**

Name of Candidate: **(Circle timing): Pre Post**

1st Trial

Circle type of trial: Cadaver / Model

Case Four: Fasciotomy

If the participant did not recognize or state the need for fasciotomy in the last case, they should be informed that the patient will need one and that they will be asked to perform it after a brief discussion/review of their understanding of the indications, pathophysiology, anatomy and steps of the procedure.

Case Presentation:

- **In the previous case you got proximal control of the femoral artery at the groin and with further dissection discovered an injury to the SFA and SFV in the mid-thigh, which you elected to shunt due to the patient's physiology.**
- **It is now nearly 5 ½ hours after the injury and you have indicated (been told) that this patient requires a fasciotomy given the high likelihood that he might develop compartment syndrome of the lower leg.**

Question #1:

Please describe exactly what compartment syndrome is and the consequences of not treating it.

Expected Answers checklist:

The participant is able to describe each of the following:		
	Yes	**No**
Compartment syndrome results from increased pressure within the defined compartments		
Increasing pressure within the compartment results in decreased tissue perfusion with ischemia and eventual death of nerve and muscle		
Pressure can increase in the compartment by increasing its contents (swelling)		
Pressure can increase in the compartment by restricting its volume (external compression)		
If untreated, nerve and muscle will die with disability / limb loss		
Untreated compartment syndrome may result in rhabdomyolsyis /kidney failure and possible death		

Question #2:

What type of injuries and non-traumatic causes are associated with the development of compartment syndrome of the lower extremity? Include causes of internal and external pressure.

Expected Answers checklist:

The participant is able to describe each of the following:		
	Yes	**No**
Fracture		
States open fracture is more likely to cause compartment syndrome than closed		
Vascular injury with prolonged ischemia		
Crush Injury		
Blast Injury		
External compression – Cast, constrictive dressing, burn eschar		
Thrombus or embolic event		
Massive fluid resuscitation		
IV infiltration		
Muscle overuse - athletes		
Snake bite or bee sting		
Hemorrhage into compartment (sickle cell, hemophilia, anticoagulants)		

Question #3

- How many compartments are in the leg?

- What are the names of the compartments?

Expected Answers checklist:

The participant describes or understands each of the following:		
	Yes	**No**
There are four Compartments in the lower leg		
Anterior Compartment		
Lateral Compartment		
Superficial Posterior Compartment		
Deep Posterior Compartment		

Question #4.

- What are the physical findings and symptoms that indicate a diagnosis of compartment syndrome in the lower leg?

- Which occur early?

- What tests can help diagnose compartment syndrome?

- When would you measure compartment pressures to help diagnose compartment syndrome?

- What compartment pressure would indicate compartment syndrome?

Expected Answers checklist:		
The participant is able to describe each of the following:		
	Yes	**No**
Relates concept that one should have a low index of suspicion for making Dx		
The five Ps: - **Pain** - **Parasthesias** - **Pallor/Pokilothermia** - **Pulslessness** - **Paralysis** Check "yes" if 3-4 correct or 5 correct	**3-4/5** **5/5**	
Limb may feel tense or hard		
States that waiting for the 5 Ps to occur is waiting too long		
Earliest sign is pain out of proportion to injury (pain with passive toe stretch)		
Loss of sensation in web space between 1st two toes		
May check compartment pressures to help with diagnosis		
Trend of myoglobin or CPK may help with diagnosis		
Check compartment pressures if exam is unreliable (drugs, head injury, paraplegia etc)		
Compartment pressure over 30 mmHg is consistent with compartment syndrome (may use up to 45 mmHg if relate controversy)		
Delta P (Diastolic BP – compartment pressure) <30 is another way to diagnose compartment syndrome		
Measuring compartment pressures can be inaccurate, so need high clinical suspicion		

You are now in the OR with the patient.

Question OR # 1:
At this time, please describe and then mark on the skin the landmarks and the incision that you plan to use.

Inform participant to mark both medial and lateral incisions before proceeding

Expected Answers checklist:

The participant Indicates and marks the following landmarks:		
	Yes	**No**
Patella		
Tibial Spine		
Tibial tuberosity/plateau		
Fibular Head		
Lateral Malleolus		
Course of Fibula		
Medial Edge of Tibia		
Medial Malleolus		

LATERAL leg incision landmarks:		
	Yes	**No**
The lateral Incision is marked one-two fingers in front of the fibula (1.5-3.0 cm)		
Upper end of incision 2-3 fingers (3.0-6.0 cm) from tibial plateau (TP)		
Lower end of incision 2-3 fingers (3.0-6.0 cm) from Lat. malleolus		

MEDIAL leg incision landmarks:		
	Yes	**No**
The Medial Incision is marked one Thumb behind the tibia (1.0-3.0 cm)		
Upper end of incision 2-3 fingers (3.0-6.0 cm) from tibial plateau (TP)		
Lower end of incision 2-3 fingers (3.0-6.0 cm) from Med. malleolus		

Now I would like you to perform the lower extremity fasciotomy. As you operate, speak out loud and identify each step of the procedure. It is not necessary to rush through the procedure—you should operate at a comfortable pace. The procedure will be deemed complete once you have decompressed all four compartments. Do you have any questions? If not please proceed.

Expected operative dissection performance checklist:

LATERAL leg incision:		
Start Incision	**Time:**	
	Yes	**No**
Identifies Intermuscular septum / correctly identifies anterior and lateral compartments		
Mentions perforating vessels as way to find IM septum		
Uses "H-Shaped" incision to open fascia		
Under-runs fascia with closed scissor tips		
Opens fascia with partially closed scissor tips		
Points tips of scissors away from septum		
Relates necessity to avoid injury to underlying nerves		
Opens fascia over anterior compartment completely, within 3 cm of fibular head and lateral maleolus		
Opens fascia over lateral compartment completely		
Finish Incision	**Time:**	

MEDIAL leg incision:		
Start Incision	**Time:**	
	Yes	**No**
Identifies and relates need to preserve greater saphenous vein and to ligate tributaries		
Correctly identify superficial posterior compartment (SPC)		
Opens entire length of fascia over superficial post compartment, within 3 cm of tibial plateau and medial maleolus		
Takes down soleus fibers from underside of tibia to enter Deep Post Compartment (DPC)		
Identifies the neurovascular bundle in the DPC		
Finish Incision	**Time:**	

Error: Incorrectly identifies the intermuscular septum, does not recognize or correct error/ fails to decompress Ant Comp	
Error: Incorrectly identifies the intermuscular septum, but is able to recognize and correct	
Error: Fails to open compartments along the entire length	
Error: Fails to identify the deep posterior compartment	

Technique points

	Score 1-5
Uses instruments properly	
Positions body to use instruments to best advantage	
Proceeds at appropriate pace with economy of movement	
Handles tissue well with minimal damage	
Creates an adequate visual field for procedure	
Communicates clearly and consistently	
Performs procedure without unnecessary dissection	
Continually progresses towards the end goal	

(5) Every time/Excellent; (4) Almost every time/Very good; (3) Sometimes/Good; (2) Rarely/Fair; (1) Never/Poor

Expert Discriminator Operative Field Maneuvers for a lower extremity Fasciotomy

	Yes	No
Operates through 'key-hole' or too small a skin incision		
Operates using full incision		
Excessive dissection		
Pointless digging and shifting around in surgical field		
Has a logical operating sequence		
Lacks anatomical knowledge		

Expert Discriminatory Instrument Use for a lower extremity Fasciotomy

	Yes	No
Improper instrument use (e.g. back-handed use)		
Incorrect instrument holding (e.g. forceps too near tips, thumb through scissors handle)		
Scalpel use: multiple tentative cuts or cuts tangentially		
Switches instruments more than you would		
Uses scissors less than you would		
Dedicated use of a single instrument.		

Questions in OR, after dissection:

What are the pitfalls or common errors that one might expect with this procedure?

Possible Answers		
	Yes	No
Not making or delaying the diagnosis of Compartment syndrome		
Performing an incomplete fasciotomy		
Missing the anterior compartment		
Missing the deep posterior compartment		
Making inadequate skin incisions		
Injury to nerve/artery/vein		

LOWER EXTREMITY FASCIOTOMY GLOBAL RATING (circle one)**:**

Technical Skills Displayed by participant during Fasciotomy:

1	2	3	4	5
The participant's technical skills were poor with much wasted moves and very poor tissue handling.	The participant demonstrated fair technical skills with some wasted movements and errors in tissue handling	The participant demonstrated good technical skills with occasional wasted movements and errors in tissue handling.	The participant demonstrated very good technical skills with minimal wasted movements and errors in tissue handling.	The participant demonstrated excellent technical skills with no wasted movements and proper respect for tissues.

Overall Understanding of the of How to make the Diagnosis of Compartment Syndrome:

1	2	3	4	5
Core knowledge is poor and there is no evidence of understanding the nuances of evaluation and diagnosis.	Core knowledge is fair with some understanding of the nuances of evaluation and diagnosis.	Core knowledge is good with moderate understanding of the nuances of evaluation and diagnosis.	Core knowledge is very good with thorough understanding of the nuances of evaluation and diagnosis.	Core knowledge is excellent with a superior understanding of the nuances of evaluation and diagnosis.

Overall Understanding of the Surgical Anatomy required for performing Fasciotomy of the Lower Extremity:

1	2	3	4	5
Poor knowledge of the regional anatomy. Unable to identify major structures or their relationships.	Fair knowledge of regional anatomy. Can name some of the major structures and their relationships	Good understanding of the anatomy. Can name most of the major structures and their relationships.	Very good understanding of anatomy. Able to point out all of the major structures and their relationships.	Excellent understanding of the anatomy, including variants. Knows the minutia, Should be teaching anatomy class.

This Participant is Ready to Perform a Two-Incision Four-Compartment Fasciotomy of the Lower Extremity:

1	2	3	4	5
Take me to another hospital please!	This participant could do the exposure fine with experienced help, but will struggle if left alone.	The participant might need to look at a text to refresh their memory but will be able to perform the exposure.	This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.	Absolutely, I hope that this individual is on call if I am injured.

Overall Understanding of the Etiology and Pathophysiology of Compartment syndrome of the Lower Extremity:

1	2	3	4	5
The participant has a poor understanding.	The participant has a fair understanding.	The participant has a good understanding.	The participant has a very good understanding.	The participant has an excellent understanding.

Evaluator's overall rating (1-100) _____

≥ 90 Excellent I hope that this individual is on call if I am injured
80-89 This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.
70-79 The participant might need to look at a text to refresh their memory but will be able to perform the exposure
60-69 This participant could do the exposure with experienced help, but will struggle if left alone
<60 Take me to another hospital please!

The overall score should be the instructor's subjective rating of how well the surgeon performed. This will be compared to the objective score for the purpose of validating the scoring method.

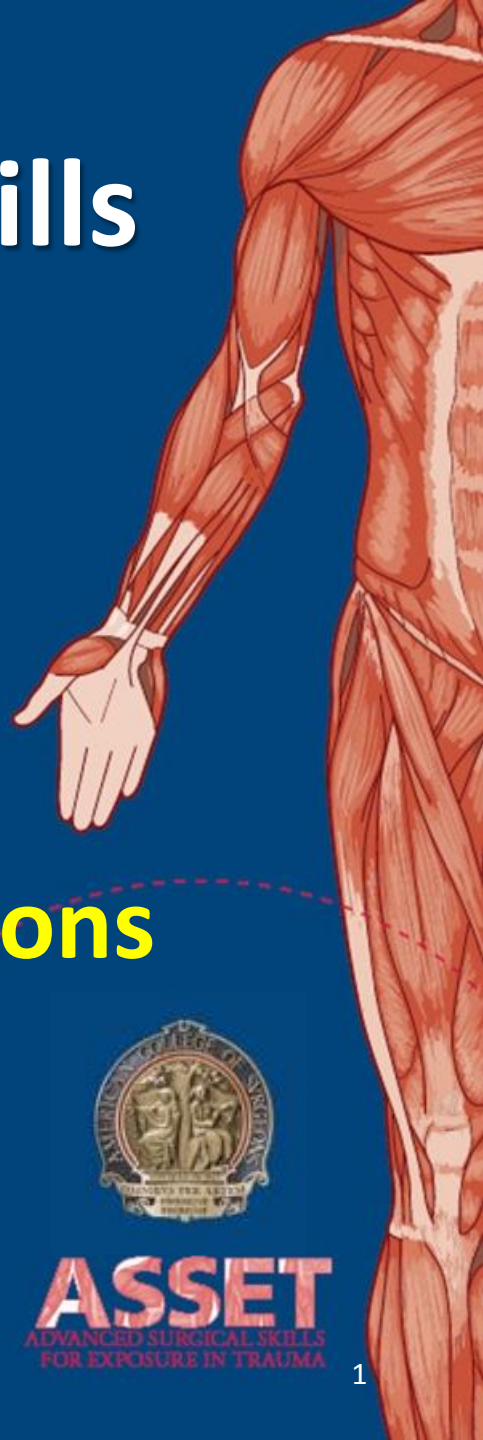
Body Habitus of cadaver (Circle):

Obese Average Thin

Cadaver Anatomy (Circe):

Normal Variant

Advanced Surgical Skills for Exposure in Trauma Course



American College of Surgeons Committee on Trauma

ASSET
ADVANCED SURGICAL SKILLS FOR EXPOSURE IN TRAUMA

Case One

- 24 y/o male was shot during an attempted robbery sustaining a single GSW to the upper anterior lateral Right/Left Chest.
- Reported to have large amount of bright red pulsatile blood at scene, but is currently not bleeding.
- He is complaining of pain at the site of the wound and inability to move his arm.

Case one

GSW to Left Lat Chest

Case one

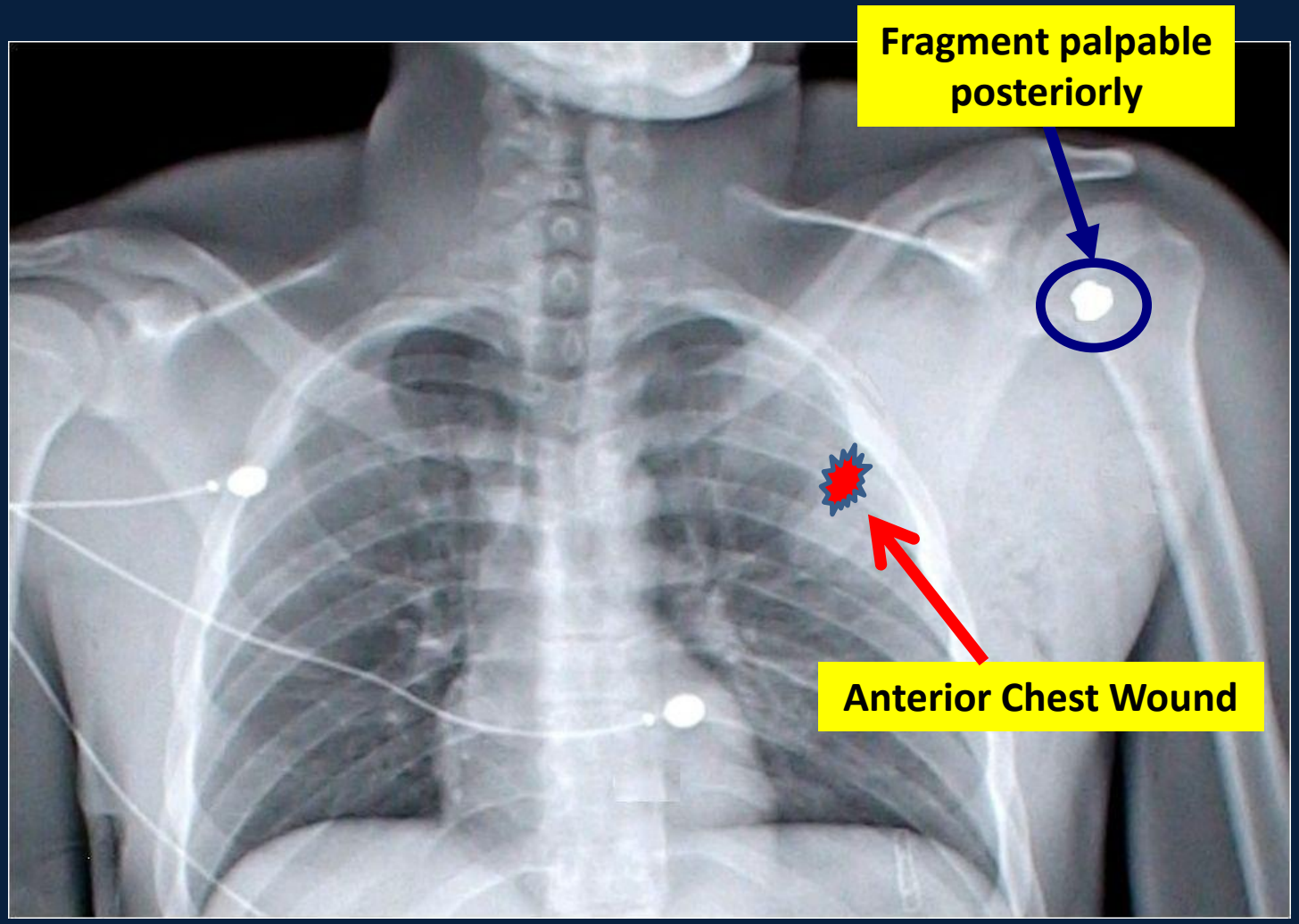
GSW to Right Lat Chest

Case one (cont)

- On arrival awake and talking, BS = Bilaterally, B/P 89/69, HR = 110 after 2 liters of lactated ringers.
- There is a single wound as seen with no other obvious trauma and no “exit wound”. His hand is cool and pale.

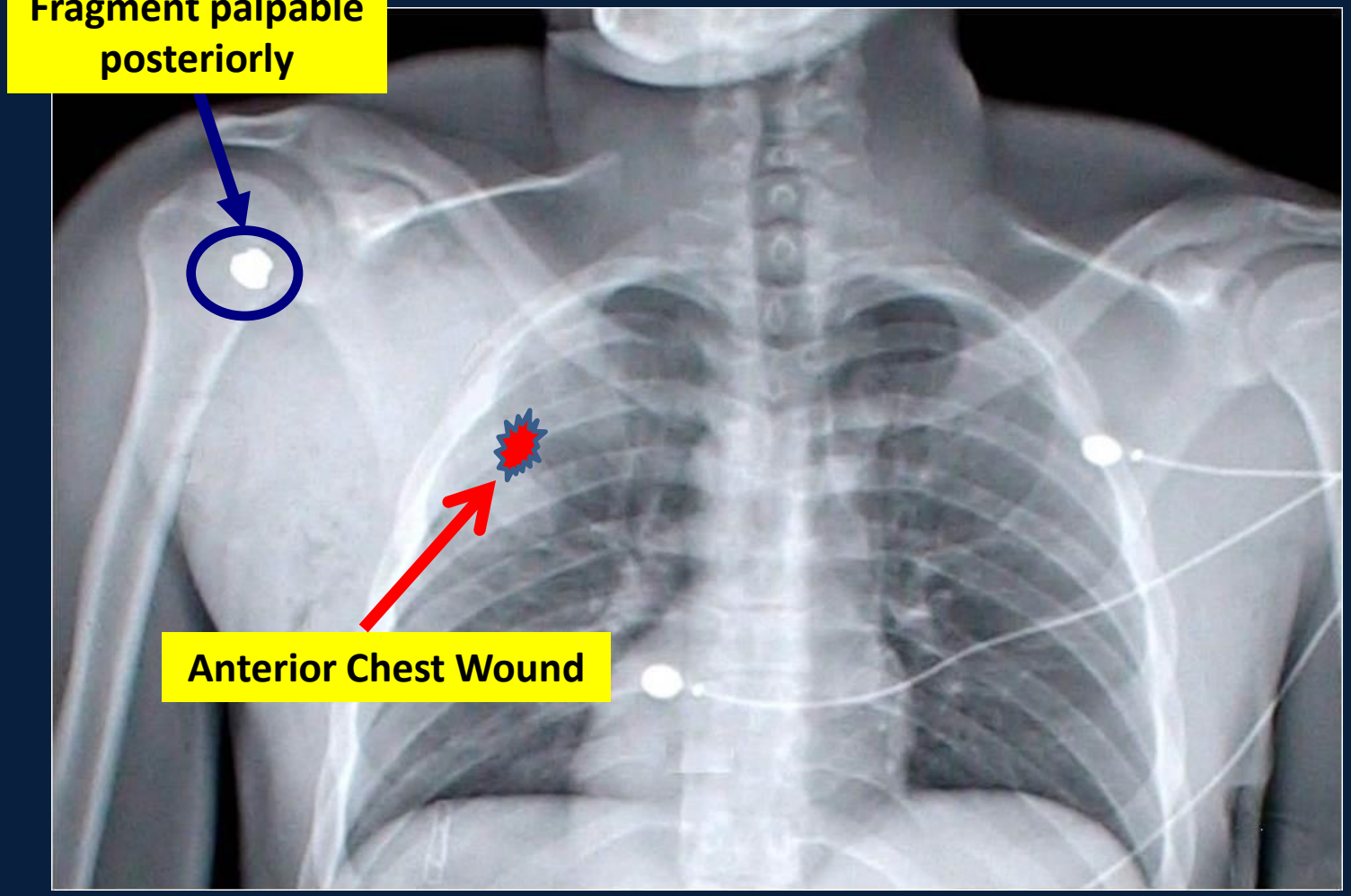
Case one - Left

- On arrival awake and talking, BP 89/69, HR = 110
- There is a single wound as seen with no other obvious trauma and no “exit wound”. His hand is cool and pale.



Case one - Right

- On arrival awake and talking, BS = Bilateral BP 89/69, HR = 110
- There is a single wound as seen with no other obvious trauma and no “exit wound”. His hand is cool and pale.



Case Two

- 32 y/o male accidentally shot in the arm at close range with a hunting rifle.
- Reported to have had large pulsatile blood loss at scene

Case two- Left

Entrance wound L dorsal forearm

Exit wound medial upper arm

Case two- Right

Entrance wound R dorsal forearm

Exit wound medial upper arm

Case two– (cont)

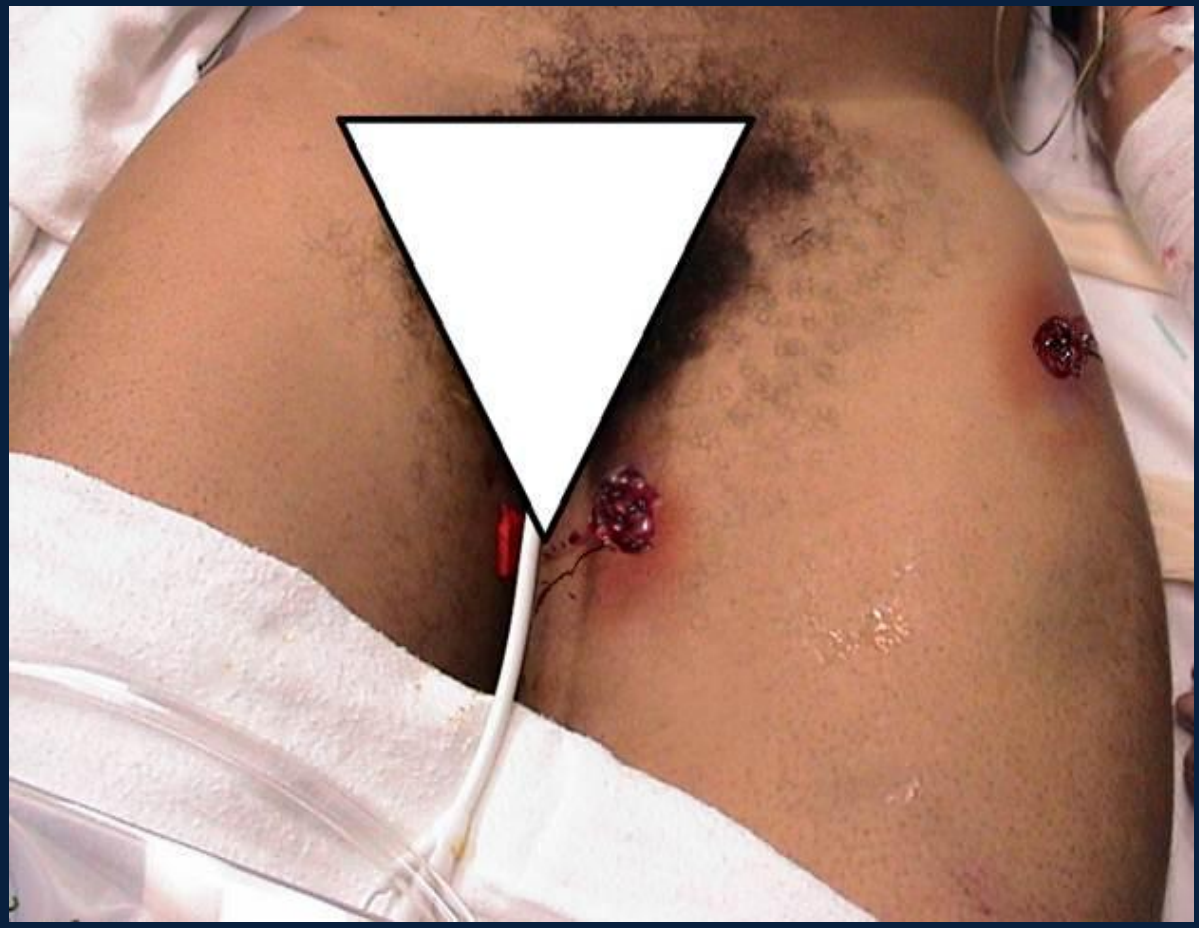
- Active pulsatile bleeding from medial wound (Controlled with direct pressure)
- Absent distal pulses
- B/P = 100/68, HR = 120
- No other injuries

Case Three

- 24 y/o male was a victim of a drive by shooting, sustaining a through/through GSW to the Right/Left mid thigh
- Reported to have a large amount of bright red pulsatile blood at the scene
- Taken to a small community hospital without an in-house surgeon: Bp was 80/50 and HR was 140
- Reported to have a markedly swollen thigh with active bleeding and no distal pulses. There are no other injuries.

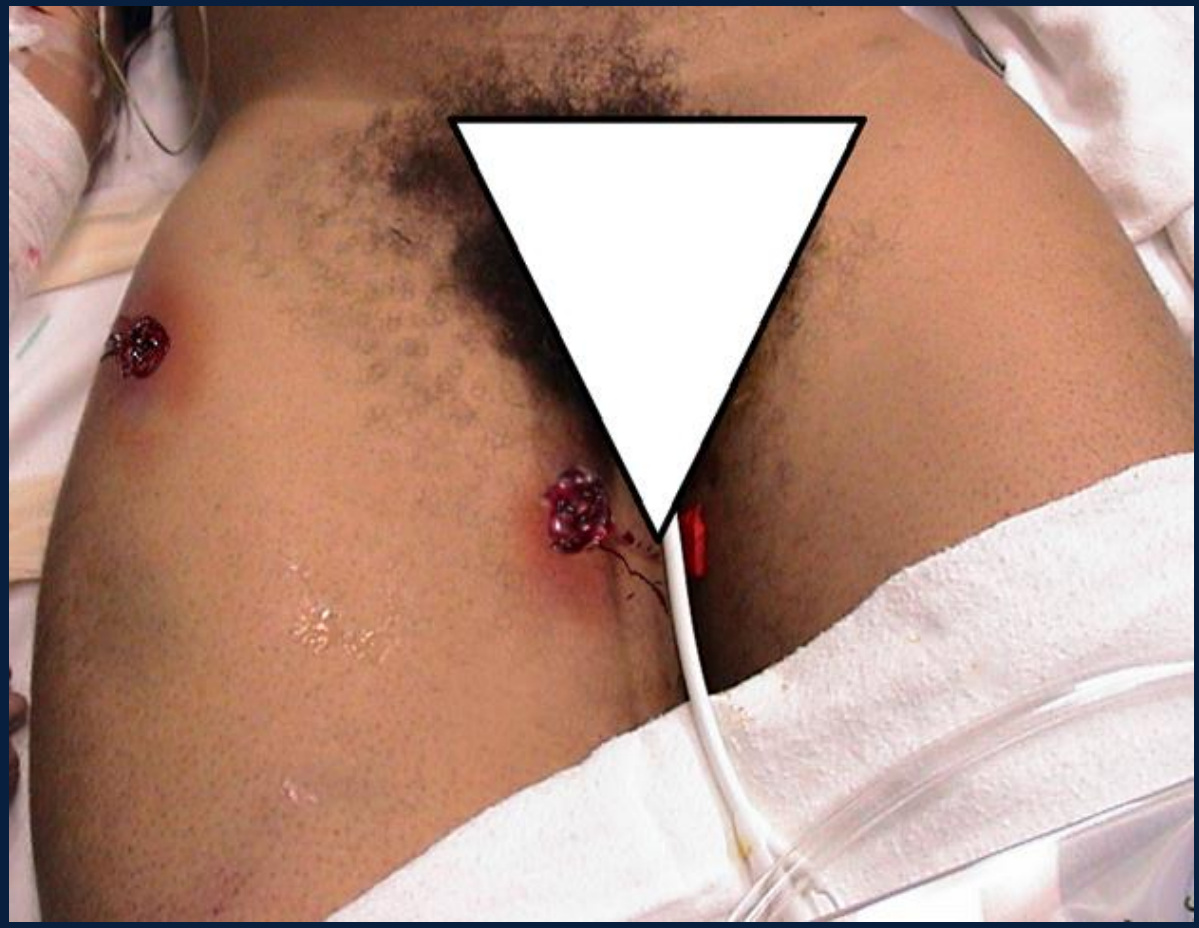
Case three - Left

Entrance/exit wound
Left mid thigh



Case three - Right

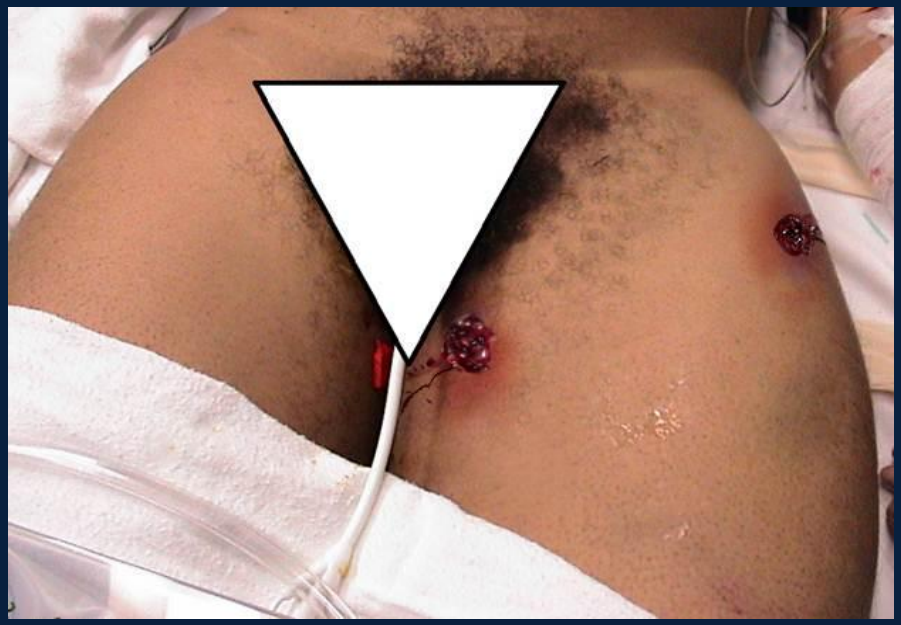
Entrance/exit wound
R mid thigh



Case three – (cont)

- Tourniquet placed at outside hospital
- Received 3000 cc of crystalloid and transferred to your facility 4hrs after injury
- Low dose norepinephrine
- Bp of 100/70 and a HR of 130, with a markedly swollen thigh and absent distal pulses.

Case three – (cont)



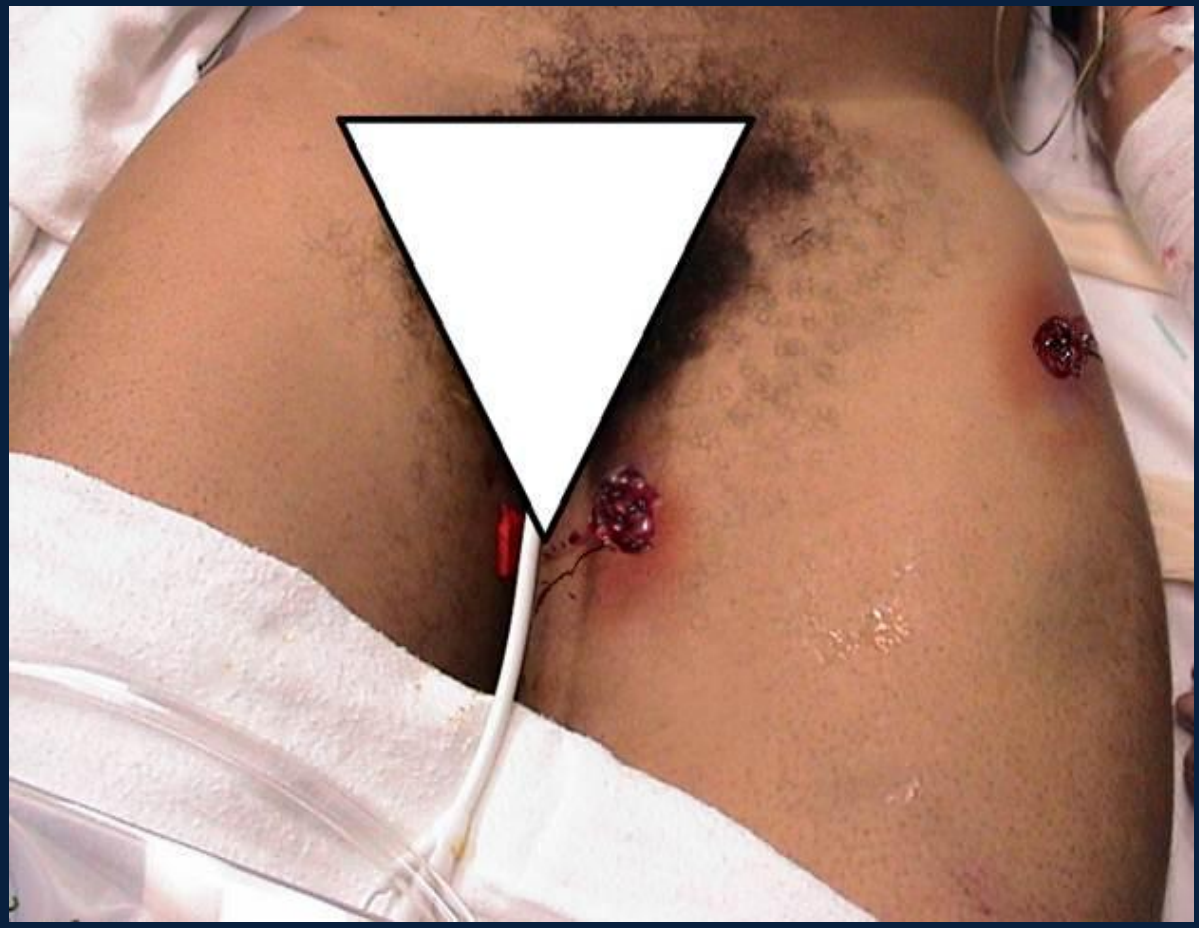
- Tourniquet placed at outside hospital
- Received 3000 cc of crystalloid and transferred to your facility 4hrs after injury
- Low dose norepinephrine with a bp of 100/70 and a HR of 130, with a markedly swollen thigh and absent distal pulses.

Case Four

- In the previous case you got proximal control of the femoral artery at the groin
- Further dissection discovered an injury to the SFA and SFV in the mid-thigh, which you elected to shunt due to the patient's physiology.
- Nearly 5 ½ hours after the injury and you have indicated (been told) that this patient requires a fasciotomy.
- Might develop compartment syndrome of the lower leg.

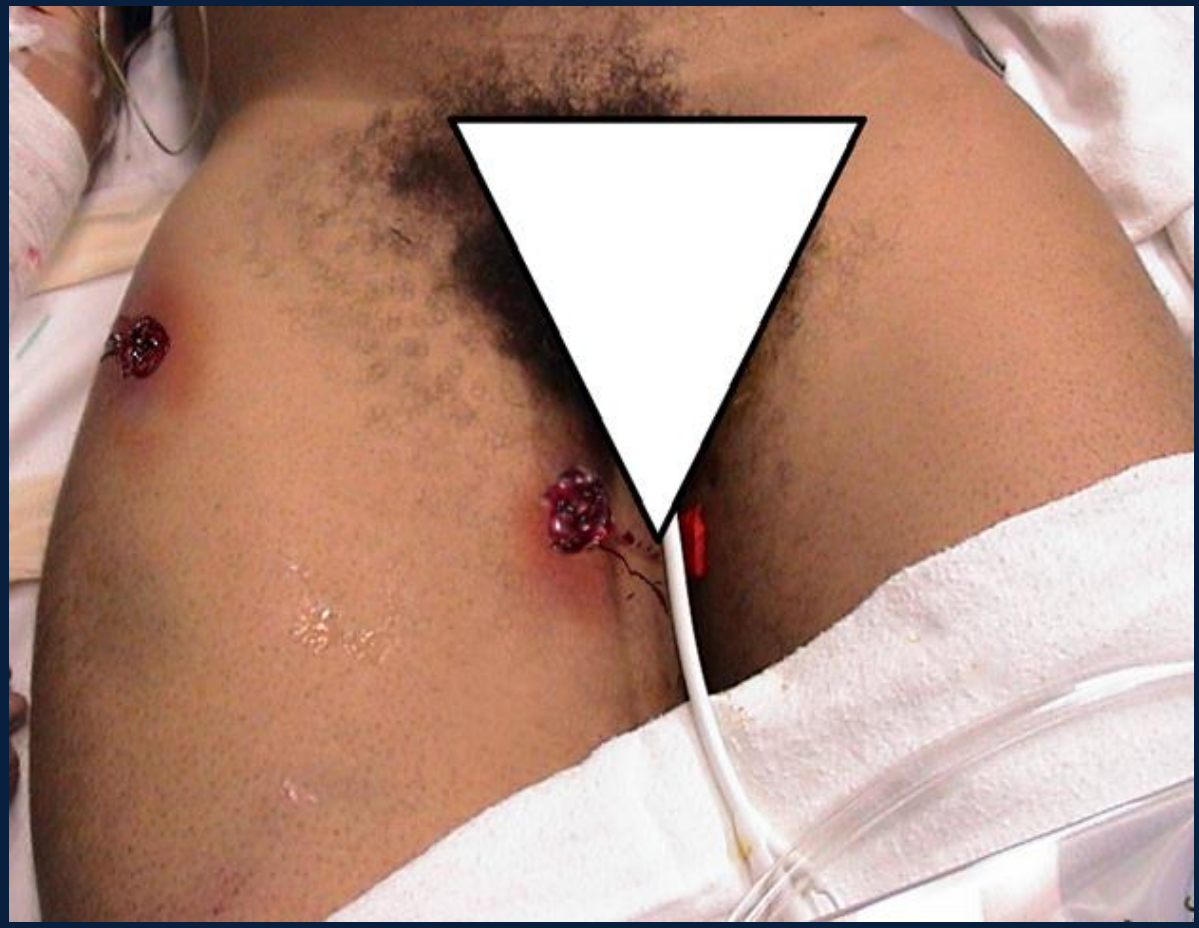
Case four - Left

Entrance/exit wound
Left mid thigh



Case four - Right

Entrance/exit wound
R mid thigh



Evaluation Sheet Examples

AXILLARY ARTERY EXPOSURE GLOBAL RATING (circle one)**:**

Overall Understanding of the Evaluation and Treatment of a Patient with a Suspected Axillary Artery Injury:

1	2	3	4	5	UTA*
Core knowledge is poor and there is no evidence of understanding the nuances of evaluation and diagnosis.	Core knowledge is fair with some understanding of the nuances of evaluation and diagnosis.	Core knowledge is good with moderate understanding of the nuances of evaluation and diagnosis.	Core knowledge is very good with thorough understanding of the nuances of evaluation and diagnosis.	Core knowledge is excellent with a superior understanding of the nuances of evaluation and diagnosis.	

Overall Understanding of the Surgical Anatomy of the Axillary Region:

1	2	3	4	5	UTA*
Poor knowledge of the regional anatomy. Unable to identify major structures or their relationships.	Fair knowledge of regional anatomy. Can name some of the major structures and their relationships	Good understanding of the anatomy. Can name most of the major structures and their relationships.	Very good understanding of anatomy. Able to point out all of the major structures and their relationships.	Excellent understanding of the anatomy, including variants. Knows the minutia, Should be teaching anatomy class.	

Technical Skills for Exposing Axillary Artery:

1	2	3	4	5	UTA*
The participant's technical skills were poor with much wasted moves and very poor tissue handling.	The participant demonstrated fair technical skills with some wasted movements and errors in tissue handling	The participant demonstrated good technical skills with occasional wasted movements and errors in tissue handling.	The participant demonstrated very good technical skills with minimal wasted movements and errors in tissue handling.	The participant demonstrated excellent technical skills with no wasted movements and proper respect for tissues.	

This participant is ready to perform exposure and control the Axillary Artery:

1	2	3	4	5	UTA*
Take me to another hospital please!	This participant could do the exposure fine with experienced help, but will struggle if left alone.	The participant might need to look at a text to refresh their memory but will be able to perform the exposure.	This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.	Absolutely, I hope that this individual is on call if I am injured.	

Overall rating (1-100):

Body Habitus of cadaver (circle): Obese Average Thin

Cadaver Anatomy (circle): Normal Variant

≥ 90 Excellent I hope that this individual is on call if I am injured
80-89 This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.
70-79 The participant might need to look at a text to refresh their memory but will be able to perform the exposure
60-69 This participant could do the exposure with experienced help, but will struggle if left alone
<60 Take me to another hospital please!

***UTA** (Unable to Assess): The detail for this determination was not possible from the video

EXPOSURE OF AXILLARY DATE: INITIALS: VIDEO FILE #:

*Technique points	Score 1-5	UTA
Exposes arteries by dissecting directly on anterior surface		
Manipulates artery by grasping adventitia		
Uses instruments properly		
Positions body to use instruments to best advantage		
Proceeds at appropriate pace with economy of movement		
Handles tissue well with minimal damage		
Creates an adequate visual field for procedure		
Communicates clearly and consistently		
Performs procedure without unnecessary dissection		
Continually progresses towards the end goal		

Surgical tasks for Axillary A. exposure	Yes	No	UTA
Initial skin incision is adequate to perform exposure			
Splits or divides Pectoralis Major			
Divides Pectoralis Minor			
Correctly identifies Axillary Artery			
Correctly identifies Axillary Vein			
Correctly identifies brachial plexus			
Controls the Axillary artery proximal to injury			

Surgical task timing for Axillary A. exposure	
Start Time – Skin Incision	
End Time – Loops Vessel	

Error: Incorrectly identifies the Axillary artery and does not recognize or correct error	
Error: Incorrectly identifies the Axillary artery but is able to recognize and correct	

***Technique point Score 1-5:**
(5) Every time / Excellent (4) Almost every time / Very good (3) Sometimes / Good (2) Rarely / Fair (1) Never / Poor

Expert Discriminator Operative Field Maneuvers for Axillary Artery Exposure

	Yes	No
Operates through 'key-hole' or too small a skin incision		
Operates using full incision		
Excessive dissection		
Pointless digging and shifting around in surgical field		
Has a logical operating sequence		
Lacks anatomical knowledge		

Expert Discriminatory Instrument Use for Axillary Artery Exposure

	Yes	No
Improper instrument use (e.g. back-handed use)		
Incorrect instrument holding (e.g. forceps too near tips, thumb through scissors handle)		
Scalpel use: multiple tentative cuts or cuts tangentially		
Switches instruments more than you would		
Uses scissors less than you would		
Uses sharp dissection (knife or scissors) confidently		

BRACHIAL ARTERY EXPOSURE GLOBAL RATING (circle one)**:**

Overall Understanding of the Evaluation and Treatment of a Patient with a Suspected Brachial Artery Injury:

1	2	3	4	5	UTA*
Core knowledge is poor and there is no evidence of understanding the nuances of evaluation and diagnosis.	Core knowledge is fair with some understanding of the nuances of evaluation and diagnosis.	Core knowledge is good with moderate understanding of the nuances of evaluation and diagnosis.	Core knowledge is very good with thorough understanding of the nuances of evaluation and diagnosis.	Core knowledge is excellent with a superior understanding of the nuances of evaluation and diagnosis.	

Overall Understanding of the Surgical Anatomy of the Arm:

1	2	3	4	5	UTA*
Poor knowledge of the regional anatomy. Unable to identify major structures or their relationships.	Fair knowledge of regional anatomy. Can name some of the major structures and their relationships	Good understanding of the anatomy. Can name most of the major structures and their relationships.	Very good understanding of anatomy. Able to point out all of the major structures and their relationships.	Excellent understanding of the anatomy, including variants. Knows the minutia, Should be teaching anatomy class.	

Technical Skills for Exposing Brachial Artery:

1	2	3	4	5	UTA*
The participant's technical skills were poor with much wasted moves and very poor tissue handling.	The participant demonstrated fair technical skills with some wasted movements and errors in tissue handling	The participant demonstrated good technical skills with occasional wasted movements and errors in tissue handling.	The participant demonstrated very good technical skills with minimal wasted movements and errors in tissue handling.	The participant demonstrated excellent technical skills with no wasted movements and proper respect for tissues.	

This participant is ready to perform exposure and control the Brachial Artery:

1	2	3	4	5	UTA*
Take me to another hospital please!	This participant could do the exposure fine with experienced help, but will struggle if left alone.	The participant might need to look at a text to refresh their memory but will be able to perform the exposure.	This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.	Absolutely, I hope that this individual is on call if I am injured.	

Overall rating (1-100):

Body Habitus of cadaver (circle): Obese Average Thin

Cadaver Anatomy (circle): Normal Variant

≥ 90 Excellent I hope that this individual is on call if I am injured
80-89 This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.
70-79 The participant might need to look at a text to refresh their memory but will be able to perform the exposure
60-69 This participant could do the exposure with experienced help, but will struggle if left alone
<60 Take me to another hospital please!

***UTA** (Unable to Assess): The detail for this determination was not possible from the video

EXPOSURE OF BRACHIAL DATE: INITIALS: VIDEO FILE #:

*Technique points	Score 1-5	UTA
Exposes arteries by dissecting directly on anterior surface		
Manipulates artery by grasping adventitia		
Uses instruments properly		
Positions body to use instruments to best advantage		
Proceeds at appropriate pace with economy of movement		
Handles tissue well with minimal damage		
Creates an adequate visual field for procedure		
Communicates clearly and consistently		
Performs procedure without unnecessary dissection		
Continually progresses towards the end goal		

Surgical tasks for Brachial A. exposure	Yes	No	UTA
Initial skin incision is adequate to perform exposure			
Creates a plane of dissection between the Bicep and Triceps			
Correctly identifies Median Nerve			
Retracts and protects Median Nerve			
Correctly identifies Brachial Artery			
Dissects Brachial Artery away from venae comites			
Controls Brachial Artery with vessel loop			

Surgical task timing for Brachial A. exposure	
Start Time – Skin Incision	
End Time – Loops Vessel	

Error: Incorrectly identifies the Brachial artery and does not recognize or correct error	
Error: Incorrectly identifies the Brachial artery but is able to recognize and correct	

***Technique point Score 1-5:**
(5) Every time / Excellent (4) Almost every time / Very good (3) Sometimes / Good (2) Rarely / Fair (1) Never / Poor

Expert Discriminator Operative Field Maneuvers for Brachial Artery Exposure

	Yes	No
Operates through 'key-hole' or too small a skin incision		
Operates using full incision		
Excessive dissection		
Pointless digging and shifting around in surgical field		
Has a logical operating sequence		
Lacks anatomical knowledge		

Expert Discriminatory Instrument Use for Brachial Artery Exposure

	Yes	No
Improper instrument use (e.g. back-handed use)		
Incorrect instrument holding (e.g. forceps too near tips, thumb through scissors handle)		
Scalpel use: multiple tentative cuts or cuts tangentially		
Switches instruments more than you would		
Uses scissors less than you would		
Uses sharp dissection (knife or scissors) confidently		

FEMORAL ARTERY EXPOSURE GLOBAL RATING (circle one)**:**

Overall Understanding of the Evaluation and Treatment of a Patient with a Suspected Superficial Femoral Artery Injury:

1	2	3	4	5	UTA*
Core knowledge is poor and there is no evidence of understanding the nuances of evaluation and diagnosis.	Core knowledge is fair with some understanding of the nuances of evaluation and diagnosis.	Core knowledge is good with moderate understanding of the nuances of evaluation and diagnosis.	Core knowledge is very good with thorough understanding of the nuances of evaluation and diagnosis.	Core knowledge is excellent with a superior understanding of the nuances of evaluation and diagnosis.	

Overall Understanding of the Surgical Anatomy of the Inguinal Region:

1	2	3	4	5	UTA*
Poor knowledge of the regional anatomy. Unable to identify major structures or their relationships.	Fair knowledge of regional anatomy. Can name some of the major structures and their relationships	Good understanding of the anatomy. Can name most of the major structures and their relationships.	Very good understanding of anatomy. Able to point out all of the major structures and their relationships.	Excellent understanding of the anatomy, including variants. Knows the minutia, Should be teaching anatomy class.	

Technical Skills for Exposing Common Femoral Artery and its Branches:

1	2	3	4	5	UTA*
The participant's technical skills were poor with much wasted moves and very poor tissue handling.	The participant demonstrated fair technical skills with some wasted movements and errors in tissue handling	The participant demonstrated good technical skills with occasional wasted movements and errors in tissue handling.	The participant demonstrated very good technical skills with minimal wasted movements and errors in tissue handling.	The participant demonstrated excellent technical skills with no wasted movements and proper respect for tissues.	

This participant is ready to perform exposure and control the Common Femoral Artery and its Branches:

1	2	3	4	5	UTA*
Take me to another hospital please!	This participant could do the exposure fine with experienced help, but will struggle if left alone.	The participant might need to look at a text to refresh their memory but will be able to perform the exposure.	This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.	Absolutely, I hope that this individual is on call if I am injured.	

Overall rating (1-100):

Body Habitus of cadaver (circle): Obese Average Thin

Cadaver Anatomy (circle): Normal Variant

≥ 90 Excellent I hope that this individual is on call if I am injured
80-89 This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.
70-79 The participant might need to look at a text to refresh their memory but will be able to perform the exposure
60-69 This participant could do the exposure with experienced help, but will struggle if left alone
<60 Take me to another hospital please!

***UTA** (Unable to Assess): The detail for this determination was not possible from the video

EXPOSURE OF FEMORAL

DATE: INITIALS: VIDEO FILE #:

*Technique points	Score 1-5	UTA
Exposes arteries by dissecting directly on anterior surface		
Manipulates artery by grasping adventitia		
Uses instruments properly		
Positions body to use instruments to best advantage		
Proceeds at appropriate pace with economy of movement		
Handles tissue well with minimal damage		
Creates an adequate visual field for procedure		
Communicates clearly and consistently		
Performs procedure without unnecessary dissection		
Continually progresses towards the end goal		

Surgical tasks for Femoral A. exposure	Yes	No	UTA
Initial skin incision is adequate to perform exposure			
Correctly identifies Common Femoral Artery			
Correctly identifies Common Femoral Vein			
Correctly identifies Profunda Femoral Branch			
Correctly identifies Superficial Femoral Artery			
Controls Common Femoral Artery with vessel loop			
Controls Profunda Femoral Artery with vessel loop			
Controls Superficial Femoral Artery with vessel loop			

Surgical task timing for Femoral A. exposure	
Start Time – Skin Incision	
End Time – Loops Vessel	

Error: Incorrectly identifies the CFA, SFA, or PFA and does not recognize or correct error	
Error: Incorrectly identifies the CFA, SFA, or PFA but is able to recognize and correct	

***Technique point Score 1-5:**
(5) Every time / Excellent (4) Almost every time / Very good (3) Sometimes / Good (2) Rarely / Fair (1) Never / Poor

Expert Discriminator Operative Field Maneuvers for Femoral Artery Exposure

	Yes	No
Operates through 'key-hole' or too small a skin incision		
Operates using full incision		
Excessive dissection		
Pointless digging and shifting around in surgical field		
Has a logical operating sequence		
Lacks anatomical knowledge		

Expert Discriminatory Instrument Use for Femoral Artery Exposure

	Yes	No
Improper instrument use (e.g. back-handed use)		
Incorrect instrument holding (e.g. forceps too near tips, thumb through scissors handle)		
Scalpel use: multiple tentative cuts or cuts tangentially		
Switches instruments more than you would		
Uses scissors less than you would		
Uses sharp dissection (knife or scissors) confidently		

FASCIOTOMY GLOBAL RATING (circle one)**:**

Overall Understanding of the Etiology and Pathophysiology of Compartment Syndrome of the Lower Extremity:

1	2	3	4	5	UTA*
The participant has a poor understanding.	The participant has a fair understanding.	The participant has a good understanding.	The participant has a very good understanding.	The participant has an excellent understanding..	

Overall Understanding of How to make the Diagnosis of Compartment Syndrome:

1	2	3	4	5	UTA*
Core knowledge is poor and there is no evidence of understanding the nuances of evaluation and diagnosis.	Core knowledge is fair with some understanding of the nuances of evaluation and diagnosis.	Core knowledge is good with moderate understanding of the nuances of evaluation and diagnosis.	Core knowledge is very good with thorough understanding of the nuances of evaluation and diagnosis.	Core knowledge is excellent with a superior understanding of the nuances of evaluation and diagnosis.	

Overall Understanding of the Surgical Anatomy Required for Performing Fasciotomy of the Lower Extremity:

1	2	3	4	5	UTA*
Poor knowledge of the regional anatomy. Unable to identify major structures or their relationships.	Fair knowledge of regional anatomy. Can name some of the major structures and their relationships	Good understanding of the anatomy. Can name most of the major structures and their relationships.	Very good understanding of anatomy. Able to point out all of the major structures and their relationships.	Excellent understanding of the anatomy, including variants. Knows the minutia, Should be teaching anatomy class.	

This participant is ready to Perform a Two-incision Four-compartment Fasciotomy of the Lower Extremity:

1	2	3	4	5	UTA*
Take me to another hospital please!	This participant could do the exposure fine with experienced help, but will struggle if left alone.	The participant might need to look at a text to refresh their memory but will be able to perform the exposure.	This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.	Absolutely, I hope that this individual is on call if I am injured.	

Technical Skills Displayed by Participant During Fasciotomy:

1	2	3	4	5	UTA*
The participant has a poor understanding.	The participant has a fair understanding.	The participant has a good understanding.	The participant has a very good understanding.	The participant has an excellent understanding..	

Overall rating (1-100):

Body Habitus of cadaver (circle): Obese Average Thin

Cadaver Anatomy (circle): Normal Variant

≥ 90 Excellent I hope that this individual is on call if I am injured
80-89 This individual will be able to perform the exposure with minimal difficulty in an expeditious fashion.
70-79 The participant might need to look at a text to refresh their memory but will be able to perform the exposure
60-69 This participant could do the exposure with experienced help, but will struggle if left alone
<60 Take me to another hospital please!

***UTA** (Unable to Assess): The detail for this determination was not possible from the video

LOWER EXTREMITY FASCIOTOMY DATE: INITIALS: VIDEO FILE #:

LATERAL leg incision landmarks:	Yes	No	UTA
The lateral Incision is marked one-two fingers in front of the fibula (1.5-3.0 cm)			
Upper end of incision 2-3 fingers (3.0-6.0 cm) from tibial plateau (TP)			
Lower end of incision 2-3 fingers (3.0-6.0 cm) from Lat. malleolus			

MEDIAL leg incision landmarks:	Yes	No	UTA
The Medial Incision is marked one Thumb behind the tibia (1.0-3.0 cm)			
Upper end of incision 2-3 fingers (3.0-6.0 cm) from tibial plateau (TP)			
Lower end of incision 2-3 fingers (3.0-6.0 cm) from Med. malleolus			

LATERAL Incision surgical tasks	Yes	No	UTA
Identifies Intermuscular septum			
Mentions perforating vessels as way to find IM septum			
Correctly identifies anterior and lateral compartments			
Uses "H-Shaped" incision to open fascia			
Under-runs fascia with closed scissor tips			
Opens fascia with partially closed scissor tips			
Points tips of scissors away from septum			
Relates necessity to avoid injury to underlying nerves			
Opens fascia over anterior compartment completely, within 3 cm of fibular head and lateral maleolus			
Opens fascia over lateral compartment completely			

MEDIAL Incision surgical tasks	Yes	No	UTA
Identifies and relates need to preserve greater saphenous vein and to ligate tributaries			
Correctly identify superficial posterior compartment (SPC)			
Opens entire length of fascia over superficial post compartment, within 3 cm of tibial plateau and medial maleolus			
Takes down soleus fibers from underside of tibia to enter Deep Posterior Compartment (DPC)			
Identifies the neurovascular bundle in the DPC			

Surgical task timing for LATERAL Fasciotomy	
Start Time – Skin Incision	
End Time – Compartment Opened	

Surgical task timing for MEDIAL Fasciotomy	
Start Time – Skin Incision	
End Time – Compartment Opened	

Error: Incorrectly identifies the intermuscular septum, does not recognize or correct error/ fails to decompress Ant Comp	
Error: Incorrectly identifies the intermuscular septum, but is able to recognize and correct	
Error: Fails to open compartments along the entire length	
Error: Fails to decompress the deep posterior compartment	

Technique points		
	Score 1-5	*UTA*
Positions body to use instruments to best advantage		
Proceeds at appropriate pace with economy of movement		
Handles tissue well with minimal damage		
Creates an adequate visual field for procedure		
Communicates clearly and consistently		
Performs procedure without unnecessary dissection		
Continually progresses towards the end goal		

***Technique point Score 1-5:**
(5) Every time / Excellent (4) Almost every time / Very good (3) Sometimes / Good (2) Rarely / Fair (1) Never / Poor

Expert Discriminator Operative Field Maneuvers for Lower Extremity Fasciotomy

	Yes	**No**
Operates through 'key-hole' or too small a skin incision		
Operates using full incision		
Excessive dissection		
Pointless digging and shifting around in surgical field		
Has a logical operating sequence		
Lacks anatomical knowledge		

Expert Discriminatory Instrument Use for Lower Extremity Fasciotomy

	Yes	**No**
Improper instrument use (e.g. back-handed use)		
Incorrect instrument holding (e.g. forceps too near tips, thumb through scissors handle)		
Scalpel use: multiple tentative cuts or cuts tangentially		
Switches instruments more than you would		
Uses scissors less than you would		
Uses sharp dissection (knife or scissors) confidently		

Cadaver Upper Extremity Realism Feedback

Compared to a live patient, please score the cadaver upper extremity on a scale of 1 to 5

	1= No reality				5 = Very realistic
Skin	1	2	3	4	5
Subcutaneous tissue	1	2	3	4	5
Muscle	1	2	3	4	5
Fascia	1	2	3	4	5
Vasculature	1	2	3	4	5
Usefulness for Training	1	2	3	4	5
Realism for training	1	2	3	4	5
Anatomic reality	1	2	3	4	5

For the cadaver upper extremity, please provide feedback on the following:

What are the strengths of the model?

What are the weaknesses?

Did you find anything about the model distracting?

Do you have suggestions for improvement?

Any other comments?

Thank you for your participation!

Cadaver Lower Extremity Realism Feedback

Compared to a live patient, please score the cadaver lower extremity on a scale of 1 to 5

	1= No reality				5 = Very realistic
Skin	1	2	3	4	5
Subcutaneous tissue	1	2	3	4	5
Muscle	1	2	3	4	5
Fascia	1	2	3	4	5
Vasculature	1	2	3	4	5
Usefulness for Training	1	2	3	4	5
Realism for training	1	2	3	4	5
Anatomic reality	1	2	3	4	5

For the cadaver lower extremity, please provide feedback on the following:

What are the strengths of the model?

What are the weaknesses?

Did you find anything about the model distracting?

Do you have suggestions for improvement?

Any other comments?

Thank you for your participation!

Upper Extremity Model Realism Feedback

Please score the realism of Upper Extremity Model features below on a scale of 1 to 5

	1= No reality				5 = Very realistic
Skin	1	2	3	4	5
Subcutaneous tissue	1	2	3	4	5
Muscle	1	2	3	4	5
Fascia	1	2	3	4	5
Vasculature	1	2	3	4	5
Usefulness for Training	1	2	3	4	5
Realism for training	1	2	3	4	5
Anatomic reality	1	2	3	4	5

For the Upper Extremity model, please provide feedback on the following:

What are the strengths of the model?

What are the weaknesses?

Did you find anything about the model distracting?

Do you have suggestions for improvement?

Any other comments?

Thank you for your participation!

Lower Extremity Model Realism Feedback

Please score the realism of Lower Extremity Model features below on a scale of 1 to 5

	1= No reality				5 = Very realistic
Skin	1	2	3	4	5
Subcutaneous tissue	1	2	3	4	5
Muscle	1	2	3	4	5
Fascia	1	2	3	4	5
Vasculature	1	2	3	4	5
Usefulness for Training	1	2	3	4	5
Realism for training	1	2	3	4	5
Anatomic reality	1	2	3	4	5

For the Lower Extremity model, please provide feedback on the following:

What are the strengths of the model?

What are the weaknesses?

Did you find anything about the model distracting?

Do you have suggestions for improvement?

Any other comments?

Thank you for your participation!

RASP Study Participant Information

Demographic Information

Name_____ Age _____ Sex _____

Institution_____ Clinical years_____

Status (circle one): Resident Chief Resident Fellow (PGY-6__ PGY-7__) Attending

Address_____

Email_____ Phone_____

Surgical Experience

What is your surgical (sub) specialty?_____

Number of months on:

Trauma Service_____ non-trauma Acute Care Service_____

Please estimate the time since you last performed surgery: Years ____ Months___ Days___

Please give the approximate number of patients for each of the following:

Trauma patients you have treated or evaluated_____

Percentage of trauma patients with penetrating trauma_____ %

Estimate the number of trauma-related procedures you have participated in for the following:

1. Upper extremity vascular repairs (open) _____
2. Upper extremity vascular repairs (endovascular) _____
3. Lower extremity vascular repairs (open) _____
4. Lower extremity vascular repairs (endovascular) _____
5. Lower extremity fasciotomy _____

Estimate the number of non-trauma related procedures you have participated in for the following:

1. Upper extremity vascular procedures for dialysis access _____
2. Other upper extremity non-dialysis vascular procedures _____
3. Lower extremity open vascular procedures _____
4. Lower extremity endovascular procedures _____
5. Lower extremity fasciotomy _____

Other than anatomy laboratory during medical school, please estimate the number of hours you have spent in a cadaver laboratory: _____

Have you taken any cadaver based courses since medical school? ____Yes ____No

If yes, please specify: _____

Estimate the amount of time you have spent in a skills laboratory during your training or in other activities:

Minimally Invasive skills tasks: _____hours

Open operative skills tasks: _____hours

Evaluation of Surgical Confidence (Pre-ASSET training)

Please indicate the number that best represents your confidence level for your understanding of the surgical anatomy in the following regions:

1	2	3	4	5
No confidence.				**Quite a lot of confidence.**

Shoulder /axillary region:	1	2	3	4	5
The arm:	1	2	3	4	5
The forearm:	1	2	3	4	5
The inguinal region:	1	2	3	4	5
The lower extremity:	1	2	3	4	5

Please indicate the number that best represents your comfort level with performing each of the following surgical procedures for <u>traumatic injury</u> *independently*.

1	2	3	4	5
No confidence. I would need significant guidance		**My confidence wavers with this procedure. I would like supervision.**		**Quite a lot of confidence. I am sure of what I am doing,**

Exposure of major vasculature in the shoulder region:	1	2	3	4	5
Exposure of major vasculature in the arm:	1	2	3	4	5
Exposure of major vasculature in the forearm:	1	2	3	4	5
Exposure of major vasculature in the inguinal region:	1	2	3	4	5
Performance of a lower extremity fasciotomy:	1	2	3	4	5

Appendix 14: Abstract for ASSET historical data for presentation at FASEB 2014

The assets of ASSET: Improving surgical performance confidence through an anatomy and skills review course for surgeons

Evan M Garofalo[1], Stacy Shackelford[1,2], Megan A Holmes[1,3], Colin Mackenzie[1], Mark W Bowyer[4].
[1]University of Maryland, Baltimore, MD, [2]C-STARS, Baltimore, MD, [3]Johns Hopkins University, [4]USUHS, Bethesda, MD

Rapid control of major hemorrhage is a primary goal in trauma surgery. However, many surgeons have little practical experience with the required vascular exposures. To address this, the American College of Surgeons developed the Advanced Surgical Skills for Exposure in Trauma (ASSET) course to review anatomy, skills and techniques for major vascular exposures. Since 2008, a broad range of participants have attended, including surgeons of many specialties, deploying military surgeons and surgery residents.

We compared self-reported confidence of participants (n=562) in surgical tasks (n=47) at baseline and directly after ASSET training to examine the effect of the course stratified by surgical experience level (resident/fellow; <8 years post-residency; 8+ years post-residency), specialty (trauma/vascular; general surgery; other specialties), and body region.

Results of Freeman-Halton 3x2 tests indicated significant gains in confidence scores for all specialties ($p<0.02$), particularly for general surgeons ($p<0.01$) and exposures in the chest ($p<0.001$), after ASSET. There was no difference in confidence gained by surgical experience. This study demonstrates the value of continuing education in applied anatomy for clinical practice. Given the frequency of vascular trauma in current military conflicts, the impact of ASSET is particularly relevant for preparing deploying surgeons for the theatre.

Appendix 15: Abstract for ACS, Expert vs Novice video review

Development of a Surgical Skills Assessment Method for Trauma

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Background: With limits on residency training hours and decrease in penetrating trauma nationally, surgical experience with managing traumatic hemorrhage has declined. An objective assessment of surgical skills in trauma would be useful in many training situations, to include course development, residency training, board certification and preparation for military deployment. We hypothesized that performance metrics for trauma surgery can reliably distinguish expert from novice surgeons.

Study Design: We performed a video task-analysis of 10 attending trauma surgeons and 10 general surgery residents during performance of three vascular exposures (axillary, brachial, femoral arteries) and lower extremity fasciotomy. Performance characteristics of expert and novice surgeons were identified and used to develop a technical skills metric score. The score includes completion of specific surgical steps and assessment of surgical technique. Five evaluators scored blinded videos of the four procedures. Interrater reliability was assessed using intraclass correlation coefficient (ICC). Expert and novice scores were compared using Kruskal-Walis test.

Results: Discriminating characteristics with best evaluator ICC between expert and novice technical skills included obtains necessary exposure ($p<0.00001$), performing procedures without unnecessary dissection ($p<0.00001$), proceeds at appropriate pace ($p<0.00001$), and performs procedure with a logical sequence ($p=0.00001$). ICC displayed in table.

Conclusion: A surgical technical skills metric score can discriminate expert from novice performance required to complete four surgical procedures through the use of discriminating performance characteristics that may be useful for objective surgical skill assessment.

	Intraclass Correlation Coefficient			
Technical Skill	**Axillary artery exposure**	**Brachial artery exposure**	**Femoral artery exposure**	**Fasciotomy**
Obtains necessary exposure	0.98	0.92	0.79	0.97

No unnecessary dissection	0.96	0.91	0.96	0.94
Proceeds at appropriate pace	0.97	0.88	0.94	0.97
Performs with logical sequence	0.93	0.87	0.97	0.95